Respiratory Disease in Canada

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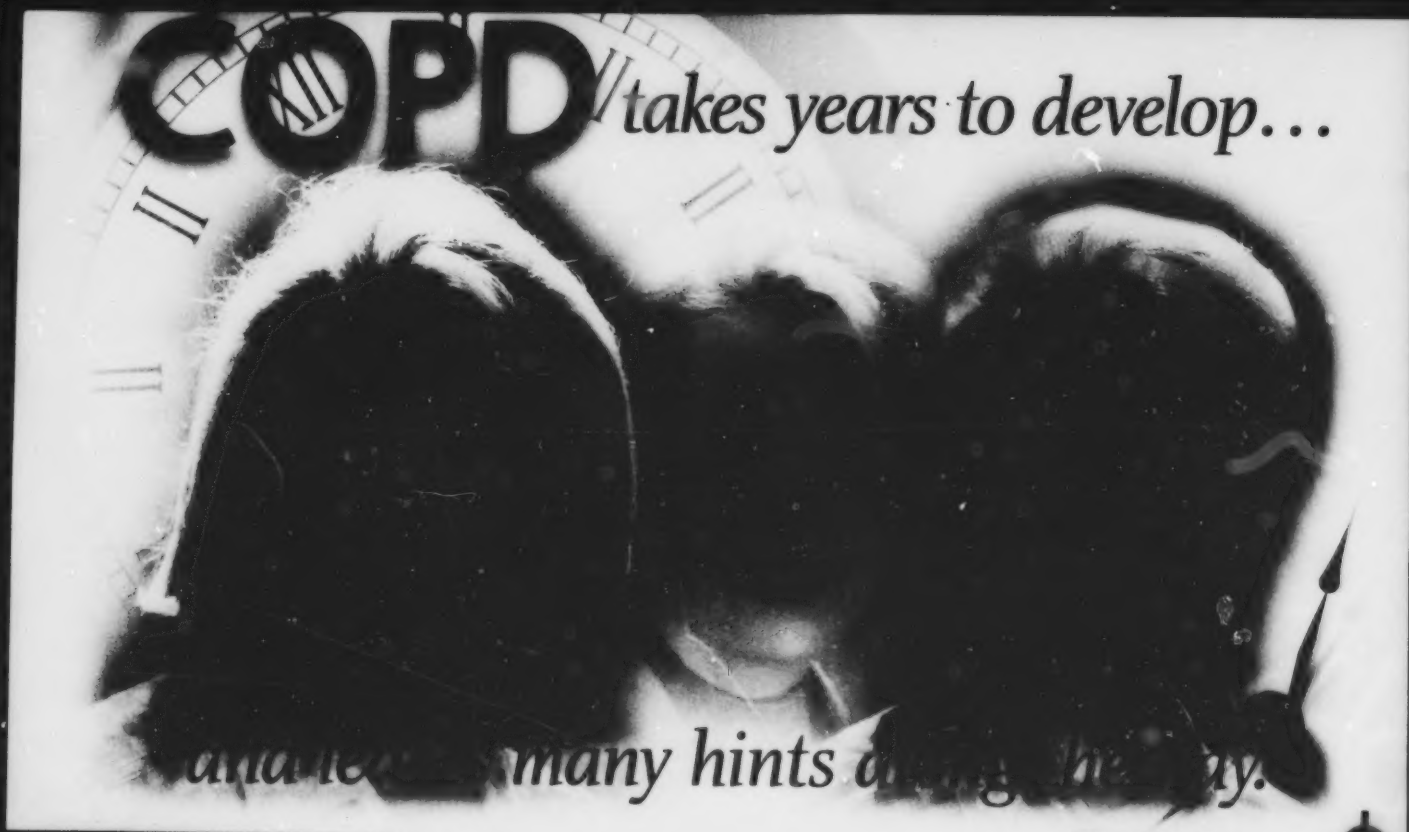

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Foreword

The purpose of *Respiratory Disease in Canada* is to provide ready access to the latest national surveillance information on communicable and chronic respiratory disease in Canada to politicians, health professionals, the media, academics and students, and managers in government, industry, and other organizations. While individual reports on some respiratory diseases are available, there is no recent document that summarizes the present state of respiratory disease in Canada. This document will serve as the starting point for regular reporting on respiratory disease in Canada.

Respiratory Disease in Canada is a collaborative effort of the Canadian Lung Association, Health Canada, Statistics Canada, and the Canadian Institute for Health Information. If you would like more copies or have any comments on the report or suggestions for future reports please contact:

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Summary

Over 3 million Canadians must cope with serious respiratory diseases - asthma, chronic obstructive pulmonary disease (COPD), lung cancer, influenza and pneumonia, bronchiolitis, tuberculosis (TB), cystic fibrosis, and respiratory distress syndrome (RDS). These diseases affect people of all ages. While in the past COPD and lung cancer have affected primarily men, the increase in smoking among women in the past 50 years has resulted in the increased incidence and prevalence of some of these diseases among women.

Respiratory diseases, including lung cancer, exert a great economic impact on the Canadian health care system. They account for nearly 12.18 billion dollars of expenditures per year (1993 dollars). These costs include the direct or visible costs of health care, such as hospitalization, physician visits and drugs (over 3.79 billion dollars). They also include the less visible or indirect expenses associated with disability and mortality, which may be even more significant (8.39 billion dollars).

This report utilizes currently available data for the surveillance of chronic respiratory diseases in Canada. While it provides a useful picture, major gaps exist in the information required to identify problem areas and monitor the impact of policies, programs and services. A more comprehensive surveillance system would include data on the incidence, prevalence, risk factors, use and impact of health services, and health outcomes. This will require an expansion of data sources. For example, an ongoing population survey would provide information on quality of life and the use of health services. Improved use and linking of administrative databases (physician billing, laboratory, drug, hospitalizations) would add more data on the use of health services and the incidence of respiratory disease. A reduction in the time lag between data collection and data release would also increase the usefulness of the existing data.

Key Points

1. Canada is facing a wave of chronic respiratory diseases. Since many of these diseases affect adults over the age of 65, the number of people with respiratory diseases will increase as the population ages. The corresponding increase in demand for services will pose a significant challenge for the health care system.
2. Tobacco is the most important preventable risk factor for chronic respiratory diseases. One in four Canadians smoke cigarettes on a daily basis. In the short term, smoking cessation among adults will have the greatest impact on reducing respiratory diseases, such as lung cancer and COPD.

3. The quality of indoor and outdoor air contributes significantly to the exacerbation of symptoms of respiratory diseases. Air quality issues are dependent on geography and solutions will vary according to locale.
4. The prevalence of self-reported asthma is higher among women than men and is increasing for both sexes. The data on activity restriction, emergency room visits and hospitalization suggest that many individuals with asthma require help in keeping their disease under control.
5. While in the past COPD was considered as primarily a man's disease, in 1998/99 more women than men reported being diagnosed with COPD. The projected increase in the number of individuals with COPD will have major implications for families and for the delivery of comprehensive hospital and community services.
6. Lung cancer is rapidly becoming a major health issue for women. Both the incidence and mortality rates among older women are increasing in contrast to the decreases seen among older men. Societal influences that encouraged women to smoke 30 to 40 years ago are now being reflected in these trends.
7. In Canada, the proportion of foreign-born TB cases is increasing, due in large part to the changing immigration patterns to Canada with more people arriving from TB-endemic areas. The spread of drug-resistant TB strains throughout the world also represents a threat.
8. Overall, influenza/pneumonia is a major contributor to deaths and hospitalization among the elderly. It is the leading cause of death from infectious disease in Canada.
9. Bronchiolitis-associated hospitalizations have increased in the last decade. The three most likely causes are the increase in the number of children in child-care centres, the changes in the criteria for hospitalization for lower respiratory tract infection, and increased survival among premature babies and those with important medical conditions that place them at high risk for serious Respiratory Syncytial Virus (RSV) infection. RSV is a primary cause of bronchiolitis.
10. The face of cystic fibrosis has changed radically in the last 20 years. While it was once almost exclusively a child's disease, most individuals with cystic fibrosis are now living into their twenties and thirties. The health care system needs to become more responsive to the needs of adults with cystic fibrosis, particularly during the teen-to-adult transition period.
11. The decrease in mortality rates for RDS attests to the success of treatment in the modern neonatal intensive care unit. Further improvements in neonatal health will require the prevention of preterm birth, the underlying cause of RDS.

A Final Word

An effective response to the challenges posed by respiratory diseases and their risk factors requires the full commitment of governments and the health care system. The first step is to recognize that respiratory diseases are major health problems in Canada. The second step involves a collaborative approach by government, voluntary organizations, health professionals and institutions toward the prevention and effective management of respiratory diseases. And finally, a fully effective comprehensive approach would include other sectors that influence indoor and outdoor air quality.

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Data Sources

Canadian Cancer Registry – Statistics Canada

Statistics Canada maintains a National Cancer Registry with information submitted by all provincial and territorial cancer registries. The registry includes demographic information as well as type of cancer. A variety of data sources, including laboratory and physician reports, are used to identify individuals to be included in the registry.

Canadian Patient Data Registry - Canadian Cystic Fibrosis Foundation (CCFF)

The Canadian Patient Data Registry of CCFF is a computerized database containing medical information on all known individuals with cystic fibrosis attending a cystic fibrosis clinic in Canada. Data are submitted annually by the 37 cystic fibrosis clinics in the country, and are maintained by the Foundation. Anonymous, aggregate statistics are available to CCFF-supported clinicians, in an effort to contribute to improved clinical care, and eventually, to a cure or control for cystic fibrosis.

The Canadian Tobacco Use Monitoring Survey (CTUMS) – Health Canada

CTUMS was initiated in 1999 to provide Health Canada and its partners with reliable data on tobacco use and related issues. The primary objective is to track changes in smoking status and amount smoked, especially for populations most at risk for taking up smoking, such as 15-24 year olds.

The target population for CTUMS is all persons 15 years of age and older living in Canada, excluding residents of Yukon, Nunavut, and the Northwest Territories, and full-time residents of institutions. In order to allow provincial comparisons of approximately equal reliability, the overall sample size for the survey is divided equally across all 10 Canadians provinces. In 1999 the sample was 22,013 individuals. The response rate was 82%.

Canadian Tuberculosis Reporting System (CTBRS) – Health Canada

From 1926 to 1996, Statistics Canada was responsible for data collection and analysis of active tuberculosis disease cases in Canada. After 1996, each province and territory reported cases of tuberculosis to the Division of Tuberculosis Prevention and Control, Health Canada. Demographic, clinical and laboratory information on each reported case are compiled and analysed. Treatment outcome evaluation was added in 1998.

Hospital Morbidity Database (HMD) – Canadian Institute for Health Information

The Canadian Institute for Health Information maintains the HMD, which covers 100% of acute care hospital separations – transfers, discharges or deaths – in Canada. A record is completed by the hospital for each individual. In addition to demographic and administrative information, the database contains up to 16 diagnostic codes and some procedures codes.

Mortality Database – Statistics Canada

Provincial and territorial offices of vital statistics submit information annually on all deaths from all provincial and territorial vital statistics registries in Canada. The personal information portion of the death registration form is completed by an informant, usually a relative of the deceased. The portion of the form comprising the medical certificate of death is completed by the medical practitioner last in attendance, or by a coroner if an inquest or enquiry was held. The database includes demographic information and the underlying cause of death as defined by the physician.

National Air Pollution Surveillance System (NAPS)

The NAPS network was established jointly in 1969 by the federal, provincial and municipal governments. Air quality data from the network give governments and the public essential information about air pollution that allow them to assess whether National Air Quality Objectives are being met. In 1999, the network consisted of 252 stations in 153 cities, with 485 continuous analyzers and 197 samplers.

National Longitudinal Survey of Children and Youth (NLSCY) – Human Resource Development Canada (HRDC)

The primary objective of the NLSCY is to develop a national database on the characteristics and life experiences of Canadian children as they grow from infancy to adulthood. The survey collects cross-sectional information as well as longitudinal data. Data collection began in 1994-1995 and will be repeated every 2 years to follow the children surveyed in 1994-1995. In subsequent years, a cross-sectional sample will be added for age groups no longer covered by the longitudinal sample.

The NLSCY target population includes children in all provinces and territories, except children living in institutions, on Indian reserves, on Canadian Armed Forces Bases and in some remote areas. The survey collects information on the child from the household member most knowledgeable about the child. Up to four children per household are chosen randomly. The survey is primarily designed for national-, regional- and some provincial/territorial-level analysis. Analysis of sub-populations is limited by insufficient sample sizes.

National Perinatal Surveillance System (NPSS) – Health Canada and Statistics Canada

The NPSS uses the data from the Statistics Canada Birth Database in the Canadian Vital Statistics System. Each year provinces and territories send their birth registration data to Statistics Canada for inclusion in the Health Canada database. The Birth Database contains demographic and obstetrical information on the mother, as well as information on the infant.

National Population Health Survey (NPHS) – Statistics Canada

The NPHS collects information related to the health of the Canadian population and related socio-demographic information. The NPHS is composed of three components: the Household Survey, the Health Care Institution Survey and the Northern Territories Survey. The NPHS Household Survey has two sections – a longitudinal panel of individuals who are surveyed every 2 years (14,900 in 1996 and 14,200 in 1998), and a cross-sectional component (17,600 in 1994/95, 81,800 in 1996/97 and 17,200 in 1998/99).

The NPHS household component includes household residents in all provinces, with the exclusion of populations in Indian Reserves, Canadian Forces Bases and some remote areas in Québec and Ontario. The first cycle of data collection began in 1994 and data will be collected every second year, for approximately 20 years in total. Three cycles of collection are now completed for each component: NPHS Cycle 1 (1994-1995), NPHS Cycle 2 (1996-1997) and NPHS Cycle 3 (1998-1999).

Notifiable Disease Reporting System (NDRS) – Health Canada

Every province and territory supplies aggregate data on notifiable communicable diseases by age group and sex on a monthly basis to the Centre for Infectious Disease Prevention and Control. The age groups and the list of most notifiable disease have changed over time in response to disease trends.

NPHS Asthma Supplement – Statistics Canada and Health Canada

The Asthma Supplement Survey was conducted as a quarterly supplement to the 1996-97 NPHS. Collection commenced in September 1996 and ended in July 1997, 3 months following each NPHS data collection period. Data were collected using a computer-assisted interviewing software package from a centralized telephone operation at Statistics Canada's head office in Ottawa. Eligible participants were those who indicated they had been diagnosed with asthma by a health care provider and had seen a physician or been on medication for asthma in the previous year. The main objective of the Asthma Survey was to provide information about the severity of asthma symptoms, associated risk factors, and management and treatment practices. Data were also collected about the utilization of medical services and asthma education.

Introduction

Breathing is one of the most vital functions of the human body. Yet most of us spend very little time thinking about this involuntary action that occurs about 12 times every minute, 24 hours a day, 7 days a week. For Canadians with respiratory disease, breathing is not something to be taken for granted!

This *Report on Respiratory Diseases in Canada* highlights the most important respiratory diseases in Canada - asthma, chronic obstructive pulmonary disease (COPD), lung cancer, pneumonia, bronchitis or bronchiolitis, cystic fibrosis, and respiratory distress syndrome (RDS). These diseases affect all ages - children, teens, adults and seniors. Most are chronic in nature and all have a major impact not only on the individual with the disease, but on the family, the community, and the health care system as well. One notable disease - acute upper respiratory infection or the "common cold" - is missing from this list of important respiratory diseases. Since it is not a reportable disease, relevant population health information is unavailable. As a result, it could not be included.

Several sources contributed data to this report. A brief description of each is provided on page xviii.

Incidence and Prevalence

Table 1-1 reveals that five serious respiratory diseases affect approximately three million Canadians. In reality, however, considering that data are unavailable for other conditions such as influenza, pneumonia, bronchiolitis and RDS, the total number affected by respiratory disease is much higher.

Table 1-1 Number of Canadians affected by respiratory diseases

Disease	Estimated Number of Canadians
Asthma - physician diagnosed (prevalence 1998/99)	2,474,400
COPD - physician diagnosed (prevalence 1998/99)	498,400
Lung cancer (new cases – 1996)	18,441
Tuberculosis (new or reactivated cases - 1998)	1,798
Cystic fibrosis (prevalence from registry- 1997)	3,142

Risk Factors

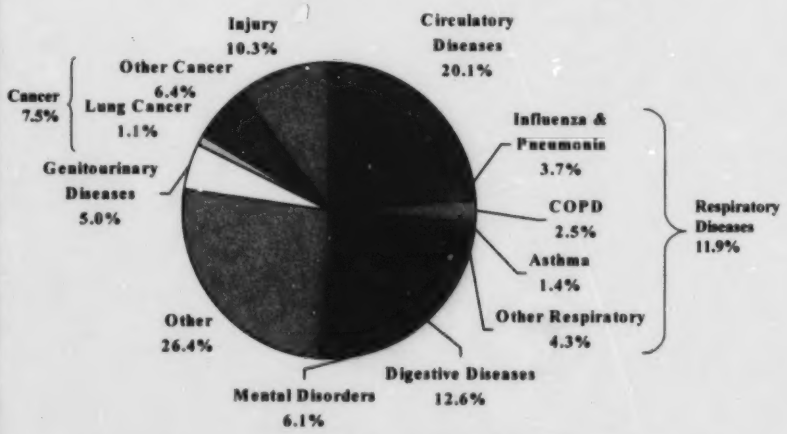
The two most important preventable risk factors for respiratory disease are smoking (both personal smoking and exposure to environmental tobacco smoke) and air quality (indoor and outdoor). The 5.7 million individuals who smoke cigarettes greatly increase their risk of developing lung cancer, COPD and asthma. Exposure to environmental tobacco smoke (ETS) affects all Canadians, causing irritation in the eyes, nose and throat. For individuals with asthma and COPD, exposure to ETS can make symptoms worse. Maternal smoking in pregnancy contributes to preterm birth, the major factor associated with the development of RDS in infants. All Canadians are affected by the quality of the air that they breathe, even more so if they already live with an existing respiratory disease.

Hospitalizations

Individuals with chronic respiratory disease may need to be hospitalized for treatment of an acute exacerbation or in the final end stage of their disease. In 1998, respiratory diseases, including lung cancer, were the third most common main diagnoses contributing to hospitalization among both men and women (Figures 1-1 & 1-2). In 1998, respiratory diseases were the primary diagnosis for 13% of all hospitalizations for men and 11% of those for women (pregnancy-related admissions are excluded).

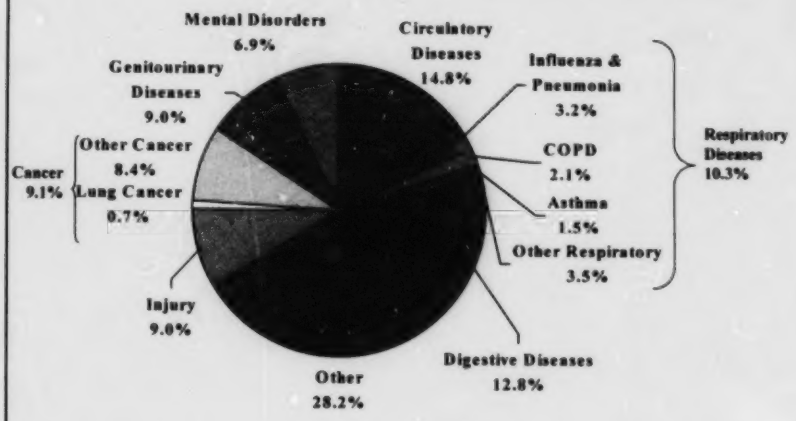
Among respiratory diseases, influenza/pneumonia was the most common main diagnosis contributing to hospitalization in 1998. The need for hospitalization for influenza/pneumonia increases in the presence of other underlying chronic respiratory conditions, such as asthma, COPD, cystic fibrosis, and lung cancer.

Figure 1-1 Proportion of all hospitalizations due to specific health problems among men, Canada, 1998.



Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

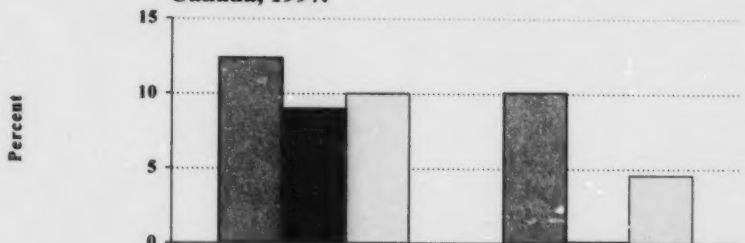
Figure 1-2 Proportion of all hospitalizations due to specific health problems among women, Canada, 1998.



Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

In 1997, among children under the age of 5 years who were hospitalized, asthma, pneumonia and bronchiolitis were frequently listed among the top five diagnoses (Figure 1-3). Asthma was a contributing factor in approximately 12% of the admissions for children under the age of 5 and 10% for those aged 5 to 14 years.

Figure 1-3 Proportion of all hospital admissions due to respiratory diseases (among first five diagnoses) among children aged 0 to 14 years by age group, Canada, 1997.

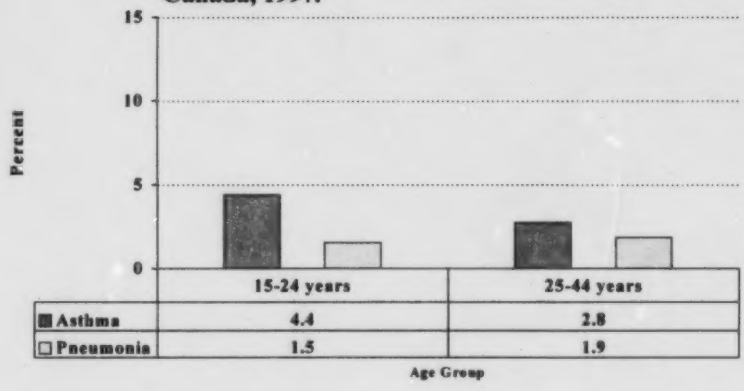


	0-4 years	5-14 years
Asthma	12.4	10.1
Bronchiolitis	9.0	0.1
Pneumonia	10.0	4.6

Age Group

Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

Figure 1-4 Proportion of all hospital admissions due to respiratory diseases (among first five diagnoses) among adults aged 15 to 44 years by age group, Canada, 1997.

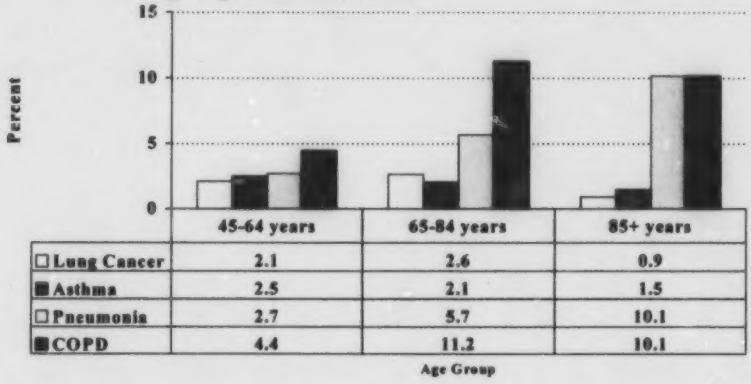


Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

Only asthma and pneumonia made a significant contribution to hospitalizations in those aged from 15 to 44 years in 1997 (Figure 1-4).

In 1997, pneumonia was a very common cause of hospitalization among the elderly (Figure 1-5). COPD contributed significantly to hospitalization in both the 65-84 and the 85+ age groups.

Figure 1-5 Proportion of all hospital admissions due to respiratory diseases (among first five diagnoses) among adults aged 45 years and over by age group, Canada, 1997.

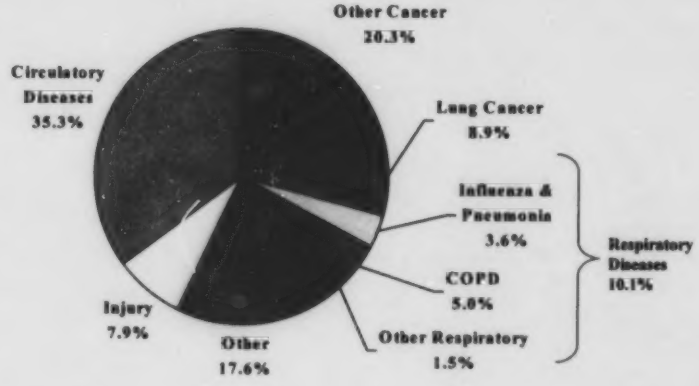


Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

Deaths

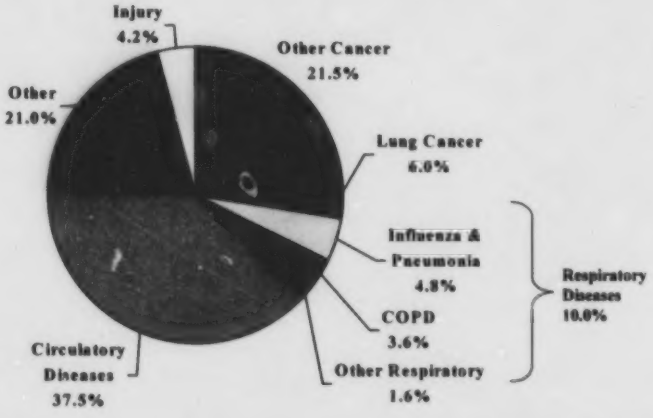
Respiratory diseases, including lung cancer, are a major cause of death in Canada (38,081 deaths in 1998) (Figures 1–6 and 1-7). In 1998, 34,707 people (19,708 men and 15,049 women) died from the most common causes of respiratory disease – lung cancer (16,261 deaths), COPD (9,398), influenza and pneumonia (9,098). Together they contributed to 18.7% of the deaths among men and 15.5% of the deaths among women. While other major respiratory diseases also contribute to mortality in Canada, the numbers are much smaller either because the case fatality rate is low (such as asthma, with 454 deaths) or because the disease is uncommon (such as cystic fibrosis, with 48 deaths).

Figure 1-6 Proportion of all deaths due to specific health problems among men, Canada, 1998.



Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from the Mortality File, Statistics Canada.

Figure 1-7 Proportion of all deaths due to specific health problems among women, Canada, 1998.



Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from the Mortality File, Statistics Canada.

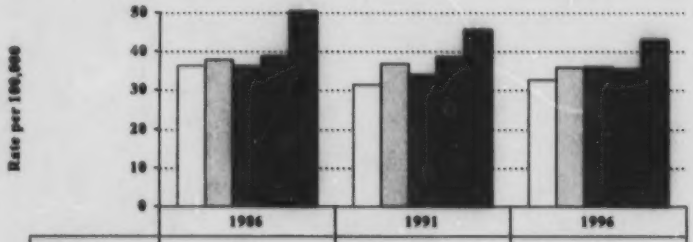
Lung cancer is a major cause of death in the 45- to 64-year-old age group for both men and women (12.6% of deaths and 13.3% of deaths respectively) (Figure 1-8). COPD plays a significant role in deaths between the ages of 65 and 84 years. In the oldest age group, influenza and pneumonia contribute to a high proportion of deaths.

Figure 1-8 Proportion of all deaths due to respiratory diseases among adults aged 45 years and over by age group, Canada, 1997.

	45-64 years	65-84 years	85+ years
Lung Cancer	12.9	8.7	1.9
Influenza/Pneumonia	1.2	3.1	7.4
COPD	1.8	5.4	4.4

Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from the Mortality File, Statistics Canada

Figure 1-9 Mortality rates for respiratory diseases by neighbourhood income quintile, urban Canada, 1986, 1991 and 1996 (age-standardized to 1991 Canadian population).



	1986	1991	1996
Highest	36.4	31.3	32.6
Upper-middle	37.8	36.7	35.7
Middle	36.2	34.1	36.1
Lower-middle	38.9	38.6	35.6
Lowest	50.2	45.5	43.1

Source: Mortality Database, Statistics Canada.

The overall mortality rate for respiratory diseases (excluding cancer) decreased by 8% between 1986 to 1996. Over the same period, the rate in the lowest quintile decreased 14%. In spite of this, the mortality rate for respiratory diseases continued to be highest in the lowest income quintile group in 1996 (Figure 1-9).

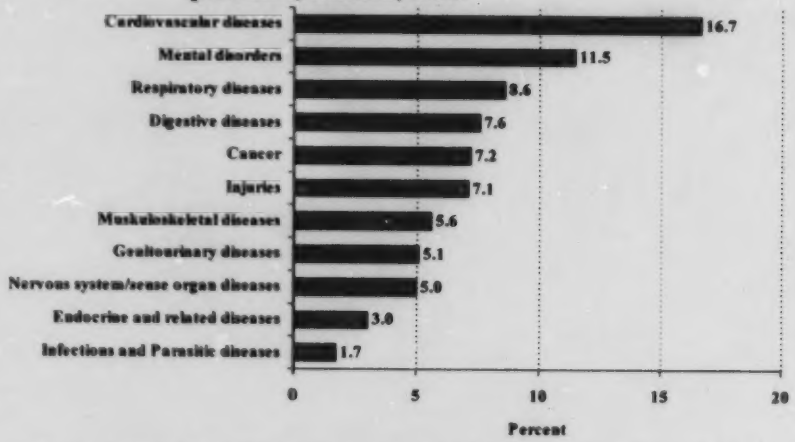
Health Care Costs[1]

Direct Costs

Respiratory diseases accounted for the expenditure of nearly 3.79 billion dollars on direct health care costs, including drugs, physician care, hospital care and research in Canada in 1993. Approximately one-third of these costs ($1.33 billion) was spent on chronic bronchitis, emphysema and asthma.

In 1993, the proportion of direct health care costs attributed to respiratory diseases ranked third among major health problems (8.6%). Only cardiovascular diseases (16.7%) and mental disorders (11.5%) ranked higher (Figure 1-10).

Figure 1-10 Proportion of direct health care costs (drugs, physicians and hospitals) due to major health problems, Canada, 1993.



Source: Laboratory Centre for Disease Control, Health Canada. *Economic Burden of Illness in Canada.* www.hc-sc.gc.ca/hpb/lcdc/publicat/burden/ 1997.

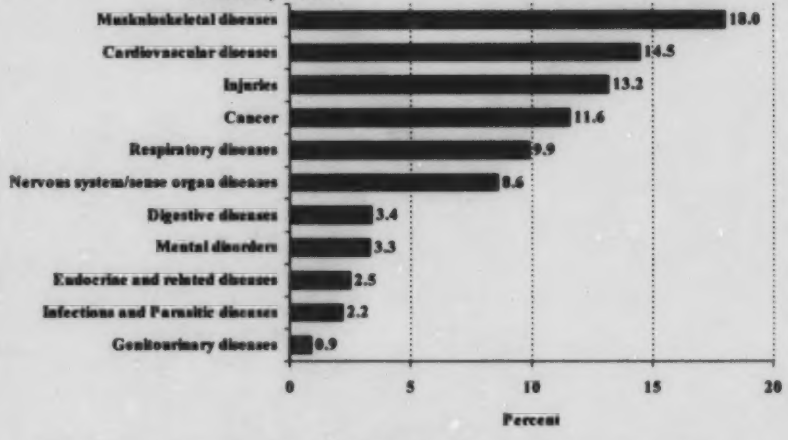
[1] HEALTH CANADA, Economic Burden of Illness in Canada, 1993. Ministry of Health, Canada, 1993. An updated report is in preparation.

Indirect Costs

Indirect costs, including mortality and morbidity costs (short and long-term disability) as measured by loss of productivity, were double the direct costs ($8.39 billion) in 1993. Approximately, one-third was attributed to chronic bronchitis, emphysema and asthma ($2.99 billion). These are often "unseen" costs because they are not seen at the front line of the health care system.

Among major health problems in Canada in 1993, respiratory diseases accounted for 9.9% of indirect health costs. It ranked fourth among health care problems, after muskuloskeletal (18.0%) and cardiovascular (14.5%) diseases, injuries (13.2%) and cancer (11.6%) (Figure 1-11).

Figure 1-11 Proportion of indirect costs (long- and short-term disability) of major health problems, Canada, 1993.

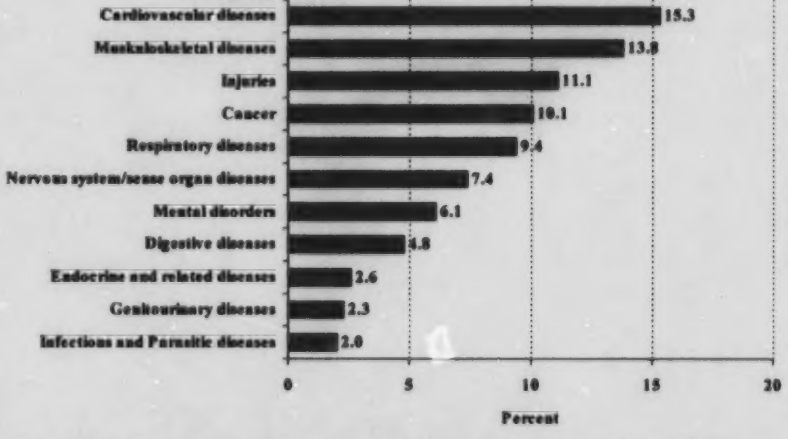


Source: Laboratory Centre for Disease Control, Health Canada. *Economic Burden of Illness in Canada.* www.hc-sc.gc.ca/hpb/lcdc/publicat/burden/ 1997.

Total Costs

In total health care costs, including both direct and indirect costs and research, the proportion spent on respiratory diseases excluding lung cancer was 9.4% in 1993. Only four health problems - cardiovascular, muskuloskeletal diseases, injuries and cancer - ranked higher (Figure 1-12).

Figure 1-12 Proportion of total health care costs (direct, indirect and research) of major health problems, Canada, 1993.



Source: Laboratory Centre for Disease Control, Health Canada. *Economic Burden of Illness in Canada.* www.hc-sc.gc.ca/hpb/lcdc/publicat/burden/ 1997.

Summary

Over 3 million Canadians must cope with serious respiratory diseases. Respiratory diseases are the third most common reason (after cardiovascular disease and cancer) for hospitalization and death.

Together, respiratory diseases exert a great economic impact on the Canadian health care system, accounting for nearly 12.18 billion dollars (1993) of expenditures per year. These costs include the direct or visible costs of the health care system (3.79 billion dollars). They also include the less visible or indirect expenses of disability and mortality, which may be even more significant (8.39 billion dollars).

Respiratory Disease in Canada highlights the importance of infectious and chronic respiratory conditions in Canada. Chapters 2 and 3 review two of the most important risk factors influencing lung health – smoking and air quality. The next six chapters focus on specific respiratory diseases that affect a significant proportion of the population. The final chapter summarizes trends in infectious and chronic respiratory diseases.

Chapter 2 Tobacco Use

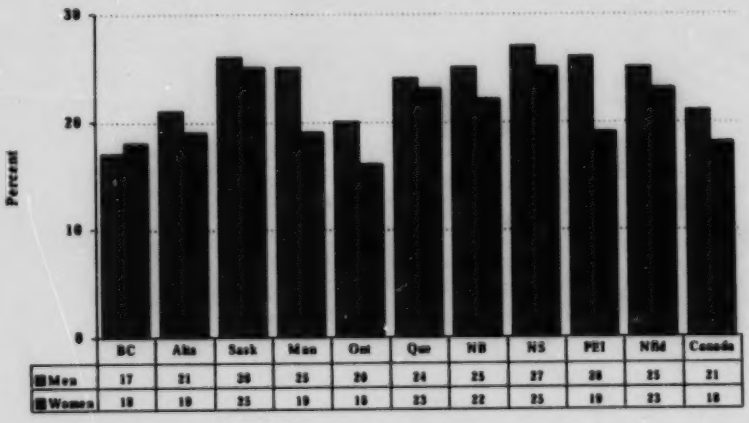
Introduction

Tobacco use is the most important preventable risk factor for respiratory disease. Exposure to tobacco smoke can either be direct as a result of cigarette smoking, or indirect as a result of maternal smoking in pregnancy or exposure to environmental tobacco smoke (ETS). Whether direct or indirect, exposure to tobacco smoke contributes to asthma, chronic obstructive pulmonary disease (COPD) and lung cancer among adults, and asthma, bronchitis and bronchiolitis, Sudden infant death syndrome (SIDS) and infant respiratory distress syndrome (RDS) among children.[1,2,3] Those who quit smoking can greatly reduce their risk of developing respiratory diseases compared with those who continue to smoke. In general, the longer the period of cessation from smoking the greater is the reduction in risk. Therefore, tobacco reduction strategies must form the cornerstone of any effort directed at preventing respiratory disease.

Smoking among Adults

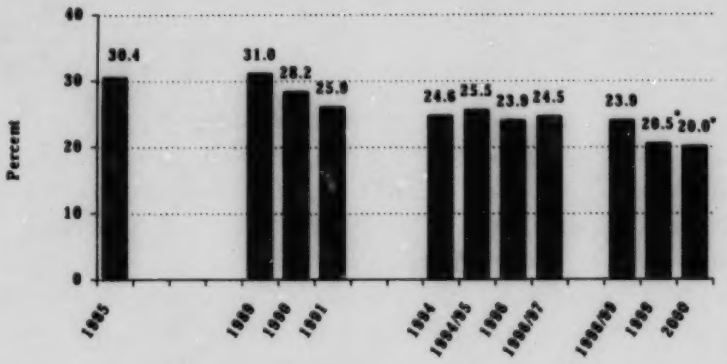
In 2000, 20% of all adults in Canada aged 15 years and over (4.9 million individuals) smoked cigarettes on a daily basis (21% or 2.5 million men and 18% or 2.2 million women). An additional 5% (1.2 million) were occasional smokers (5% or 0.6 million men and 5% or 0.6 million women) (Figure 2-1).

Figure 2-1 Proportion of adults aged 15+ years who were daily smokers by sex and province, Canada, 2000.



Source: Canadian Tobacco Use Monitoring Survey, February-December 2000.

Figure 2-2 Proportion of adults aged 15+ years who were daily smokers, Canada, 1985-2000.

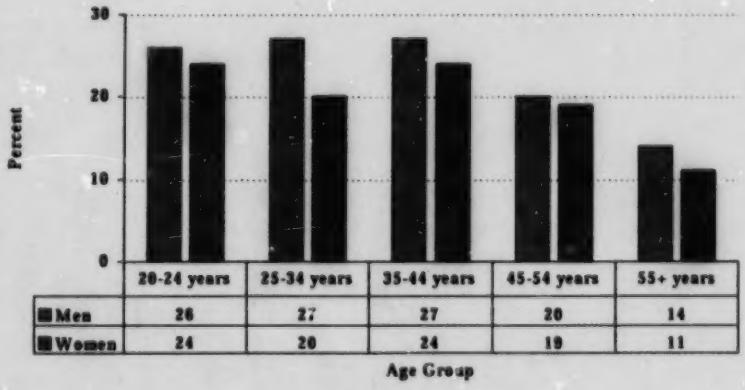


Sources: Gilmore, J. *Report on Smoking Prevalence in Canada, 1985 to 1999.* (Statistics Canada, Catalogue 82F0077XIE), 2000.
*Canadian Tobacco Use Monitoring Survey, 1999, 2000.

Overall, daily smoking prevalence decreased from 1985 to the mid-1990s (Figure 2-2).

In 2000, except for those aged 15 to 17 years (see Figure 2-6), a higher percentage of men than women smoked cigarettes on a daily basis in all age groups. The prevalence of smoking decreased among men and women after the age of 45 (Figure 2-3).

Figure 2-3 Proportion of adults who were daily smokers by age group and sex, Canada, 2000.

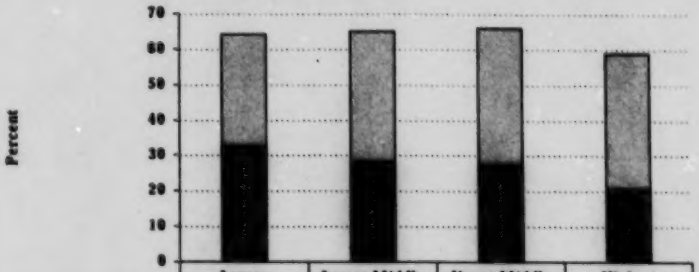


Source: Canadian Tobacco Use Monitoring Survey, February-December 2000.

In 1998/99, income was inversely related to prevalence of current smoking.

While the overall proportion of ever smokers was only slightly lower in the "highest" income group (58.9%) than in the lowest income group (64.2%), higher quit rates in the higher income group result in over one-third fewer current smokers in the higher income group (Figure 2-4).

Figure 2-4 Proportion of adults aged 25+ years who were current or former smokers by income adequacy* level, Canada, 1998/99.



	Lower	Lower Middle	Upper Middle	Highest
Former smokers	31.3	36.6	38.5	38.1
Current smokers	32.9	28.4	27.6	20.8

Income Adequacy*

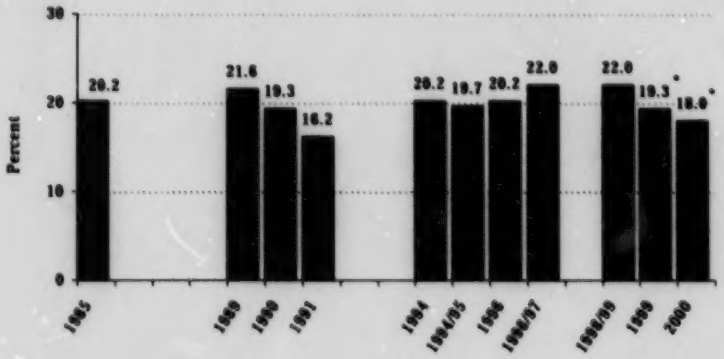
*Income adequacy - based on the number of individuals and total income in a household.

Source: Statistics Canada, National Population Health Survey, 1998/99.

(*For a more detailed explanation of "Income Adequacy", see Glossary.)

Smoking among Youth

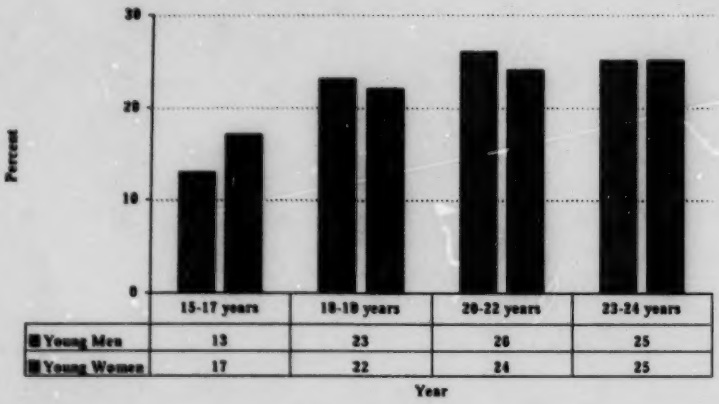
Figure 2-5 Proportion of youth aged 15-19 years who smoked cigarettes daily, Canada, 1985-2000.



Sources: Gilmore, J. *Report on Smoking Prevalence in Canada, 1985 to 1999.* (Statistics Canada, Catalogue 82F0077XIE), 2000.
*Canadian Tobacco Use Monitoring Survey, February-December 2000.

Between 1985 and 2000, approximately 20% of youth aged 15 and 19 smoked cigarettes daily. Slight variations in the proportion from year to year may reflect different survey methodologies (Figure 2-5).

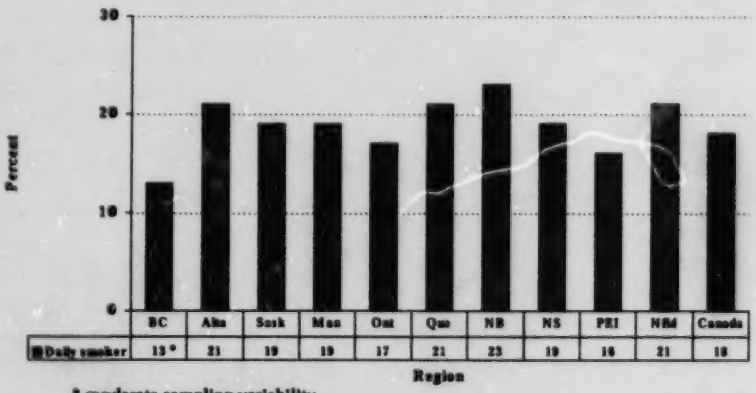
Figure 2-6 Proportion of youth and young adults aged 15-24 years who smoked cigarettes daily by age group and sex, Canada, 2000.



Source: Canadian Tobacco Use Monitoring Survey, February-December 2000.

In 2000, among youth and young adults, a higher proportion of women than men aged 15-17 years smoked. In the older age groups, the proportions of men and women were similar (Figure 2-6).

Figure 2-7 Proportion of youth aged 15-19 years who reported smoking cigarettes daily by province, Canada, 2000.



* moderate sampling variability

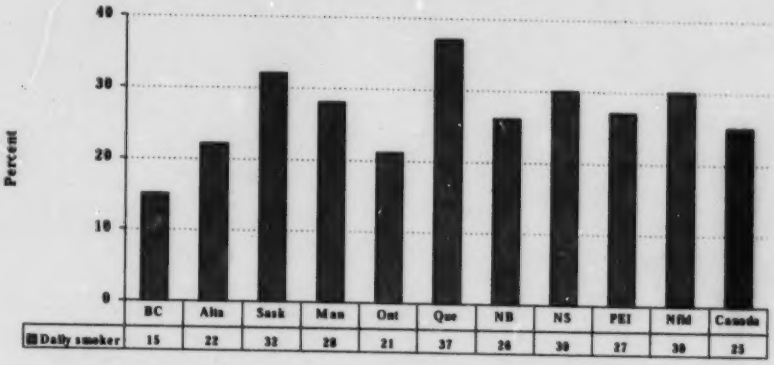
Source: Canadian Tobacco Use Monitoring Survey, February-December 2000.

In 2000, B.C., Ontario and P.E.I. appeared to have the lowest proportion of youth aged 15 to 19 years who smoked daily (Figure 2-7).

Exposure to Environmental Tobacco Smoke (ETS)

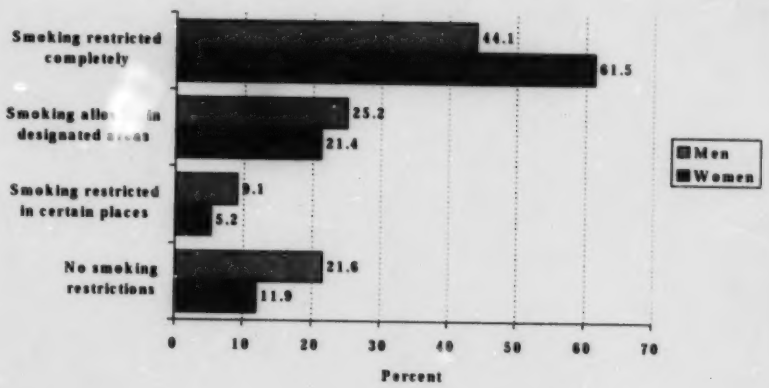
In 2000, approximately 900,000 children under 12 years of age (25%) were exposed to environmental tobacco smoke (ETS) in the home every day or almost every day. Children living in Quebec were more likely to be exposed to ETS than those in the other provinces (Figure 2-8).

Figure 2-8 Proportion of children under 12 years of age who were exposed to environmental tobacco smoke in the home every day or almost every day by province, Canada, 2000.



Source: Canadian Tobacco Use Monitoring Survey, February-December 2000.

Figure 2-9 Proportion of adults aged 15 to 75 years who reported workplace smoking restrictions by sex, Canada, 1998/99.



Source: Statistics Canada, National Population Health Survey, 1998/99.

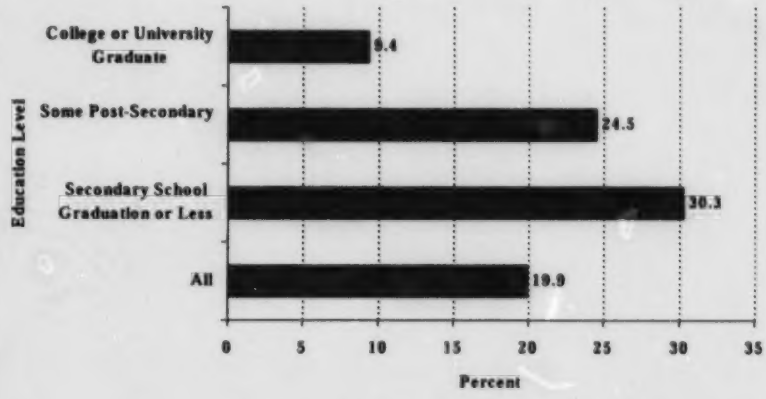
In 1998/99, a higher percentage of women than men reported that smoking was restricted in their workplaces. Smoking was completely restricted in the workplace for 61.5% of women compared to only 44.1% of men. Approximately one-fifth (21.6%) of men reported no restrictions in their workplace compared to only 11.9% of women (Figure 2-9).

Prevalence of Maternal Smoking in Pregnancy

Maternal smoking in pregnancy leads to an increased risk of asthma among children. (See Chapter 4.) It also contributes to preterm birth, which may result in RDS in the infant. (See Chapter 9.)

According to the 1996/97 National Longitudinal Survey of Children and Youth, 19.9% of women smoked during pregnancy. Lower education was associated with higher prevalence of smoking in pregnancy (Figure 2-10).

Figure 2-10 Proportion of women who reported smoking during pregnancy by education level, Canada, 1996/97.



Source: National Longitudinal Survey of Children and Youth, 1996/97.

Discussion and Implications

Since the mid-1980s, federal and provincial departments of health and non-governmental organizations with an interest in tobacco control have worked together to reduce tobacco use. The goals of the strategy are prevention, cessation and protection. Various interventions have been implemented to help non-smokers stay smoke-free, to encourage and help smokers who want to quit, and to protect the health and rights of non-smokers.*

Yet in spite of these efforts, one Canadian in five still smokes cigarettes on a daily basis. Despite best efforts to reduce smoking among youth, a number of youth continue to become addicted throughout adolescence and young adulthood. Smoking will continue to cause major health problems among Canadians unless more aggressive tactics toward prevention and cessation are undertaken. In the short term, smoking cessation among adults will have the greatest impact on reducing respiratory diseases, such as lung cancer and COPD.

A very high proportion of children under 12 years of age continue to be exposed to the toxic chemicals found in environmental tobacco smoke in the home. Parental or caregiver smoking not only affects the health of the children, but also sends the message that smoking is an acceptable adult behaviour. Continued efforts are needed so that parents and other family members understand the importance of maintaining a smoke-free environment.

Although progress continues to be made in making workplaces smoke free, more action is needed. The difference between smoking restrictions reported by men and women in their workplaces suggests that more women than men are protected from the effects of ETS. More aggressive efforts are required in work settings that include a high proportion of men.

References

[1] Surgeon General. Reducing the Health Consequences of Smoking: 25 Years of Progress. Washington, D.C. U.S. Government Printing Office, 1989.

[2] National Cancer Institute. Health Effects of Exposure to Environmental Tobacco Smoke: The Report of the California Environmental Protection Agency. Smoking and Tobacco Control Monograph no. 10. Bethesda, MD. U.S. Department of Health and Human Services, National Institutes of Health, NIH Pub. No. 99-4545, 1999.

[3] Makomaski Illing EM, Kaiserman MJ. Mortality attributable to tobacco use in Canada and its regions, 1994 and 1996. Chron Dis Can 1999;20:3:111-17.

* Additional information on tobacco reduction and an inventory of smoking cessation programs is available at the National Clearinghouse on Tobacco and Health at (613) 567-3050 and at its web-site at http://www.cctc.ca/ncth.

Chapter 3
Air Quality and Respiratory Health

Introduction

Increasingly, the air quality in our homes, schools, non-industrial work places and recreational facilities, as well as ambient air, have been questioned in relation to health. The relationship between air quality and health is difficult to understand, however, because of the complex interplay of numerous factors such as personal exposures, genetics, underlying diseases, behaviour, dietary patterns, home environment, geographic location, and weather patterns. Although indoor and outdoor air quality can affect cardiovascular health and possibly other systems, this review focuses on respiratory health.

Outdoor Air

Air pollution can provoke devastating health effects. For example, the 1952 London Fog, an atmospheric inversion, caused 4,000 deaths.[1] Since then, air pollution control programs have brought about considerable reductions in the levels of many ambient air pollutants. A large body of recent research evidence, however, has demonstrated that significant adverse health effects are still observed even at the relatively low levels of exposure that we currently experience.

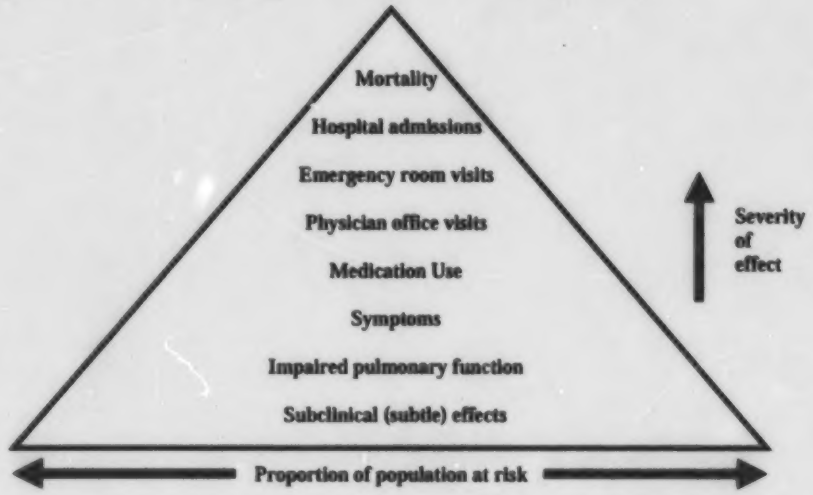
Emissions of pollutants affect Canada's air quality through the combustion of fossil fuels in motor vehicles, smelters, homes, thermal power plants, and industry. The primary pollutants of interest with regard to health include ground level ozone, particulate matter (PM), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), and carbon monoxide (CO). The degradation of air quality occurs through the formation of smog and acid rain.

Acute Effects

Research on the respiratory health effects of current levels of outdoor air pollution has revealed a link with premature deaths and increased rates of hospitalization.

These acute effects of exposure may indicate a very large burden of illness for the population (Figure 3-1).

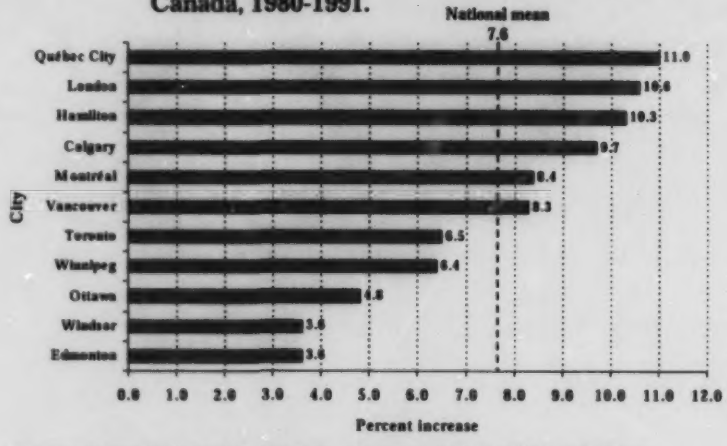
Figure 3-1 Cascading health effects of air pollution.



Source: Stieb DM, Pengelly LD, Arron N, Taylor SM, Raizenne M. Health effects of air pollution in Canada: Expert findings for the Canadian Smog Advisory Program. Can Respir J 1995;2(3):155-60.

Health Canada estimates that in 11 major Canadian cities, air pollution is responsible for 5,000 premature deaths. Between 1980 and 1991, the percentage increased risk of death attributable to the city-specific change in air pollution concentrations ranged from 3.6% in Edmonton and Windsor to 11.0% in Quebec City (Figure 3-2).[2]

Figure 3-2 Percentage increased risk of death attributable to change in air pollution concentrations by city. Canada, 1980-1991.



Source: Burnett R, Cakmak S, Brook JR. The effect of urban ambient air pollution mix on daily mortality rates in 11 Canadian cities. Can J Pub Health 1998;89(3):152-6.

The linkage of air pollution data with hospital admissions data for 16 cities across Canada assisted in demonstrating that increasing levels of ground-level ozone coincided with increased admissions to hospital for respiratory diseases.[3] The strongest association was for the highest hourly ozone concentration recorded on the day before admission to hospital. About 80% of air pollution-related hospital admissions have been attributed to the gaseous mix (SO_2, NO_2, CO) and 20% to particulate matter (PM).[4] The subtle tissue effects of exposures to air pollution are believed to be more problematic for individuals already compromised with asthma, bronchitis, emphysema, respiratory infection or cardiac disease. A major concern for health authorities is that severe health outcomes can be associated with relatively low levels of outdoor air pollution.[5,6,7]

There is substantial evidence that asthmatics can experience significant adverse health responses, including increased symptoms and medication use in relation to many outdoor air contaminants.[8,9,10,11] Studies also illustrate a relationship between use of medical services and exacerbations of respiratory disease as a result of exposure to outdoor air pollutants.[12,13] A study conducted in Saint John, NB investigated the relationship between daily ground-level ozone concentrations and emergency department visits for asthma.[14] Results showed that asthma visits increased by 33% (from approximately 1.4 to 1.9 visits per day) 2 days after the daily maximum exceeded 75 ppb, compared with days when this level was not exceeded. Individuals with asthma have been shown to have a more severe reaction to an allergen if previously exposed to high concentrations of ozone.[15]

Long-term Effects

Research related to the health outcomes associated with long term exposures to ambient levels of air pollution is limited. An analysis of mortality risk ratios in more polluted cities versus least indicated that there was a 15% to 17% increased risk of death over a 8 year period as a result of exposures to ambient levels of sulfate and particulate respectively.[16] An earlier study, involving six U.S. cities where subjects were followed for 14 to 16 years, found similar results.[17] Long-term exposure to ambient levels of air pollution has also been linked to lung cancer. A recent cohort study of more than 6,000 non-smokers found that there was an increased risk of lung cancer in males and females exposed to elevated long-term ambient concentrations of specific pollutants.[18] The relationship between chronic exposure to ambient levels of air pollution and respiratory diseases, such as chronic obstructive pulmonary disease (COPD), is yet to be discerned.

Effects on Children

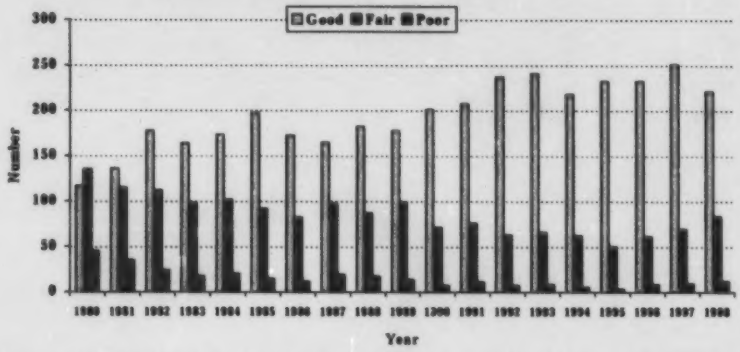
Children are especially sensitive to their environments because of rapid growth, developing body systems, unique pathways of exposure, and higher intakes of air, water and food. Studies that have investigated the impact of outdoor air pollution specifically on children have noted increased cough and wheeze, increased use of airway medications, increased physician and hospital respiratory visits, and a permanent reduction of lung capacity.[19,20] The health effects of exposure to acidic air pollution was investigated among children 8-12 years old living in 24 communities in the United States and Canada. Results of the study indicate that the long-term exposure to acidic particles may have a harmful effects on lung growth, development and function with the length of exposure time being a potential factor.[21] Although no Canadian studies have evaluated the effect of ambient air pollution on mortality in children, an American study did find an association between exposure to particulate air pollution and sudden infant death syndrome (SIDS).[22]

Trends in Outdoor Air Pollution

The National Air Pollution Surveillance Network (NAPS) monitors the quality of ambient air in Canadian cities and towns. Although the air quality in Canada has improved over the last 30 years, levels of pollutants and smog remain concerns in particular areas of the country. A useful index for an overall assessment of air quality is the number of good-fair-poor days.

Since 1980, there has been some general improvement across Canada, albeit with considerable variation (Figure 3-3). The increase in the number of fair and poor quality days in the last 3 years has been attributed to higher levels of ground-level ozone and particulate matter (PM).

Figure 3-3 Number of good-fair-poor air quality days, Canada, 1980-1998*.



* The Air Quality Index (AQI) is based on the National Ambient Air Quality Objectives (NAAQOs) which have been defined under the Canadian Environmental Protection Act (CEPA) and provide a uniform scale for assessing the quality of the air in all parts of Canada. In the past, these objectives were set for three levels: desirable, acceptable and tolerable. Using pollutant concentrations and the set levels, air quality can be defined as good, fair or poor. The index increases with deteriorating air quality. A rating of good air quality equates to pollutant levels being at or better than maximum desirable levels. A fair air quality rating relates to pollutant levels being in the range of maximum desirable to maximum acceptable. The poor air quality rating indicates that pollutant levels are between maximum acceptable and maximum tolerable levels. (TSP data were used and extrapolated to compute the index.)

Source: National Air Pollution Surveillance Network (NAPS), Pollution Data Branch, Environment Canada, 2000.

Sources of Outdoor Air Pollution

Gaseous Pollutants

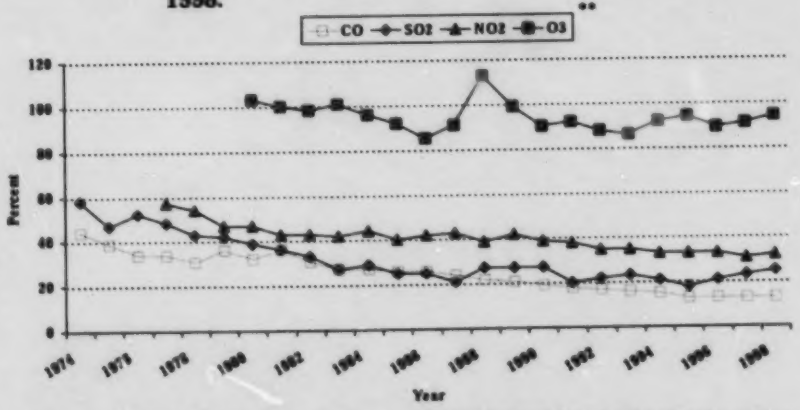
In terms of the gaseous pollutants, NO_2, SO_2 and CO, levels declined from the mid-1970s to the mid-1990s (Figure 3-4). Since 1995, SO_2 levels have increased slightly corresponding to a rise in emissions from thermal power generators. SO_2 and NO_2 are the major causative pollutants for acid rain and acidic aerosols. Non-ferrous smelters and coal-fired power plants are the principal sources of SO_2 while NO_2 is mainly related to motor vehicle emissions. SO_2 emissions in Eastern Canada are a particular focus for Environment Canada given the high acid deposition in the region.

Ozone

Ground-level ozone is formed by a series of chemical reactions involving sunlight, NO_2 and volatile organic compounds. High temperatures (above 25° C), local topography and stagnant air masses, which facilitate the accumulation of pollutants, influence this process. Ozone formation peaks during April to September when periods of high temperatures and sunlight are most likely to occur. Maximum daily levels of ozone occur in the afternoon between noon and 6:00 p.m.

Between 1981 and 1998 ground-level ozone appeared to decrease (Figure 3-4). However, many regions frequently experienced levels of ozone that exceeded the present air quality standard of 82 ppb (daily 1 hour maximum concentration) (Table 3-1).

Figure 3-4 Percentage of maximum acceptable levels, ground-level ozone and gaseous pollutants*, Canada, 1974-1998.



*Maximum Acceptable Level is defined as the concentration that provides adequate protection against adverse effects on humans, animals, vegetation, soil, water, materials and visibility.

**CO: carbon monoxide; SO2: sulphur dioxide; NO2: nitrogen dioxide; O3: ground-level ozone

Source: National Air Pollution Surveillance Network (NAPS), Pollution Data Branch, Environment Canada, 2000.

Table 3-1 Number of hours the ozone standard was exceeded, by region, Canada, 1979-1994

	Canada	Atlantic Canada	Central Canada*	Prairies	British Columbia
1979	25.2		28.2	9.0	39.0
1980	21.1	12.6	30.1	1.4	16.5
1981	20.5	5.9	25.7	5.4	25.4
1982	10.4	4.0	14.5	3.6	6.5
1983	26.3	0.0	42.4	0.7	8.1
1984	14.4	47.8	16.3	7.5	2.8
1985	8.9	1.3	12.5	0.2	8.8
1986	8.3	0.0	12.6	0.4	2.9
1987	12.0	9.0	19.5	0.9	0.2
1988	51.0	8.2	83.0	0.9	10.2
1989	13.9	9.5	22.5	1.5	1.0
1990	8.8	7.1	12.8	0.6	4.3
1991	14.8	8.5	25.0	0.4	0.0
1992	4.9	0.5	8.5	0.0	0.0
1993	3.1	0.3	5.5	0.3	0.0
1994	6.5	2.5	10.5	0.7	1.0

Source: Environment Canada. *Canada's National Environmental Indicator Series,* August 1998.

* Windsor-Quebec City corridor

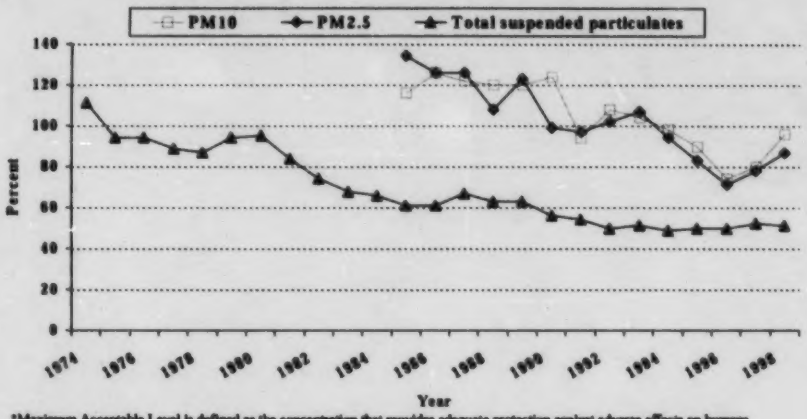
The areas of principal concern for ozone episodes include the Windsor-Quebec City corridor (Ontario and Quebec), the lower Fraser Valley (British Columbia), and the southern Atlantic Region. The Windsor- Quebec City corridor, the most industrialized part of Canada, continues to experience the highest number of ozone events. Environment Canada estimates that air pollutants from the United States are responsible for up to 50% of the ozone formation in the southwestern region of Ontario and up to 75% in the southern Atlantic region.

Particulate Matter

PM levels in the atmosphere are a combination of natural and human-produced sources. The National Air Pollution Surveillance Network (NAPS) began surveying PM_{10} (particles of median diameter of 10 micrometers or less) and $PM_{2.5}$ (particles of median diameter 2.5 micrometers or less) since 1984 using specialized samplers. The $PM_{2.5}$ fraction of PM can penetrate deep into the lungs and are thought to pose the highest risk to human health. These particles consist of a broad range of chemical species which can include sulphates, nitrates, organic compounds, acidic aerosols, and metals.

Levels of particulate matter (PM) declined overall from the mid-1970s to the mid-1990s (Figure 3-5).

Figure 3-5 Percentage of maximum acceptable levels* for particulate matter (PM), Canada, 1974-1998.**



*Maximum Acceptable Level is defined as the concentration that provides adequate protection against adverse effects on humans, animals, vegetation, soil, water, materials and visibility.

**Percentage of maximum acceptable levels shown for TSP. Canada wide standard was used for PM 2.5 and provincial standard was used for PM10.

Source: National Air Pollution Surveillance Network (NAPS), Pollution Data Branch, Environment Canada, 2000.

Canadian National Ambient Air Quality Objectives

National ambient air quality objectives (NAAQOs) have traditionally been the benchmark against which Canada assesses the impact of human activities on air quality and ensures that current emission control policies are protecting human health and the environment. The first Canadian NAAQOs were developed in the mid-1970s. These objectives consisted of a three-tiered approach (maximum desirable, acceptable and tolerable levels) that identified ranges of air quality with specific levels of effect.

During a 1992 review of the air quality objectives, it became apparent that many air pollutants had no effect thresholds or very low effect thresholds making the establishment of scientifically defensible effect levels difficult. The subsequent new NAAQOs framework specifies two levels: a Reference Level, which is the level above which there are demonstrated effects on human health and/or the environment; and an Air Quality Objective (AQO), which is a concentration that reflects a specified level of protection for the general population and environment, but which also considers aspects of technical feasibility.

The air quality objectives must be consistent with the philosophy of the Canadian Environmental Protection Act (CEPA) and be based on recognized scientific principles that include risk assessment and risk management.[23] The NAAQOs are set by the federal government based on recommendations from a National Advisory Committee and Working Group on Air Quality Objectives and Guidelines. Provincial governments have the option of adopting these either as objectives or as enforceable standards using their legislation. The Reference Level and AQO are based on the development of an

extensive Science Assessment Document (SAD), which reviews the relevant scientific evidence. The SAD and AQOs are subject to peer review and stakeholder consultations processes.

More recently, the federal and provincial governments have agreed to establish Canada-Wide Standards (CWS) for substances of high priority. These include two substances that were being developed as AQOs (Particulate Matter and Ozone). CWSs are science-based in the same manner as AQOs, but also explicitly recognize and incorporate a number of other factors including technical feasibility and economic issues. CWSs have the explicit buy-in of federal and provincial governments and involve the development of jurisdictional risk management plans to attain the agreed-upon standard. Stakeholder consultation is a fundamental aspect of the CWS process and is conducted on all aspects of the standard and associated management plans both at the provincial and federal level.

Indoor Air

Results from the Canadian Human Activities Pattern Survey (CHAPS) indicate that adults in Canada spend about 90% of their time indoors.[24] Indoor air quality is influenced by concentrations in outdoor air pollution, combustion appliances, personal sources (environmental tobacco smoke [ETS], pets), consumer products, and the building fabric.[25] As multiple concomitant exposures may heighten sensitivities, a combination effect is important to consider when indoor air exposures are suspected to be a cause of illness.

The National Academy of Sciences recently reviewed the evidence for the development of asthma in children.[26] They concluded that there is substantial evidence of a causal relationship between exposures to house dust mites and asthma. This is because there is specific knowledge of the allergens produced by dust mites and there are good studies that are generally lacking for other agents. There is a strong association between exposure to environmental tobacco smoke (ETS) among pre-school aged children. Though some research demonstrates a relationship between exposures to cockroach allergens among pre-school aged children and the respiratory syncytial virus (RSV) and the development of asthma, the evidence was deemed to be only limited or suggestive.

Exposure to ETS (pre-school children), cat and dog allergens, cockroaches, dust mites, NO_2 or NO_x (high-level exposures), fungi, and rhinoviruses have been shown to be related to the exacerbation of asthma.[27,28,29,30] Limited or inadequate evidence exists to assess the relationship between the exacerbation of asthma and indoor exposures to fragrances, formaldehyde, pesticides, plasticizers or volatile organic compounds (VOCs). Indoor air quality may also influence other respiratory diseases, such as COPD. Much less research has been done for these diseases in comparison to asthma.

Sources of Indoor Air Pollution

External Air

All the pollutants in outdoor air can be found in the indoor environment. Indoor SO_2 concentrations are estimated to be lower than outdoor levels by approximately 20 to 70%.[31] Indoor ozone levels are generally much lower than outdoor concentrations as ozone is a highly reactive gas. Indoor levels of ozone are approximately 10 to 30% of levels found outdoors. Ambient fine particles, CO and NO_2 are all found indoors at higher percentages than outdoor concentrations.[32,33]

Environmental Tobacco Smoke (ETS)

About one-quarter of Canadian children under 12 years of age are regularly exposed to ETS.[34] (See Figure 2-8 in Chapter 2.) Children exposed to ETS have an increased chance of developing pneumonia, bronchitis, otitis media, chronic respiratory symptoms, impaired lung function and sudden infant death syndrome. Adults exposed to ETS report increased respiratory symptoms such as cough, chest discomfort, increased sputum production, and a mild decrease in lung function. Chronic exposure to ETS has also been associated with lung cancer and other malignancies.[35,36]

Biological Material

Biological contaminants, including bacteria, viruses and allergens produced by cats, dogs, domestic birds, fungi, house dust mites, and cockroaches are common causes of allergic disease, asthma and respiratory symptoms. Fungal allergens may cause allergic rhinitis, allergic asthma and hypersensitivity pneumonitis.[37,38] Exposures to bacterial and viral agents can cause respiratory tract infections. Studies of adults and children living in homes with reported dampness or mould growth indicate an increased risk of upper respiratory symptoms ranging from cough to dyspnea.[39,40]

Combustion Products

Wood smoke (wood burning stoves), comprised primarily of CO, NO_2 and inhalable particles, has been shown to impair lung defences in children thereby increasing susceptibility to respiratory infections. According to a Harvard study, there may be up to a 30% increased risk of developing a chest illness if exposed to wood smoke.[41] There is some concern about high NO_2 exposures from the use of unvented kerosene heaters or gas cooking stoves for heating purposes. NO_2, an oxidant, is soluble in lung tissue. Damage to lung tissues can occur directly or indirectly through the reduction of lung defence mechanisms.[42]

Elevated levels of CO can occur in the indoor environment in relation to emissions from gas cooking stoves, unvented kerosene space heaters and barbecues. CO can disrupt oxygen transport making sensitive individuals especially susceptible to adverse health effects.[43] Susceptible populations would include persons with cardiovascular and respiratory diseases and the elderly.

SO_2 is another combustion product that is a potential contaminant of indoor air associated with ill health. The pollutant is extremely irritating to the upper respiratory tract. Asthmatics have been

shown to be particularly sensitive to acute exposures of SO_2 as bronchoconstriction can occur within minutes of exposure even at low concentrations.[44,45]

Radioactive Materials

Radon (radioactive gas) is a well-known human carcinogen. Indoor exposure to radon gas is considered to be the second leading cause of lung cancer after smoking.[46,47]

Indoor Air Guidelines

Canada has Exposure Guidelines for residential indoor air quality that were developed in 1995 by the Federal-Provincial Advisory Committee on Environmental and Occupational Health. The report provides a summation of key health effects and recommended exposure levels or exposure controls for 19 substances. The guidelines were developed for domestic premises and assume an exposure of 24 hours per day.

The Federal-Provincial Advisory Committee on Environmental and Occupational Health has also formulated a guidebook for assessing the indoor air quality in office buildings. The guide is intended for use by property managers, building maintenance staff, health and safety officials and consultants working in the occupational environment field to facilitate indoor air quality investigations.

Additionally, the Committee developed a guidebook on dealing with fungal contamination in public buildings *(Fungal Contamination in Public Buildings: A Guide to Recognition and Management)*. This guide has been designed to assist in the recognition and management of fungal contamination problems in public buildings. It also strives to further the understanding of the health significance of fungi detected in the course of building investigations. The guide applies to public buildings excluding hospitals and industrial settings.

The above documents are available by contacting the Safe Environments Directorate publications unit at Publishing Unit, Safe Environments Directorate, Health Canada, A.L. 0801A, Ottawa, Ontario, Canada, K1A 0L2.

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Additional information sites:

http://www.hc-sc.gc.ca/hecs-sesc/air_quality/index.htm ((Health Canada - Air Quality)

http://www.hc-sc.gc.ca/ehp/ehd/catalogue/bch.htm#technical (Technical Reports and Publications)

http://www.hc-sc.gc.ca/ehp/ehd/catalogue/bch_pubs/pdf/air_quality/tr-156.pdf (Indoor Air Guidelines)

http://www.hc-sc.gc.ca/ehp/ehd/catalogue/general/iyh/microbio.htm (Microbiological Contamination and Indoor Air)

http://www.ccme.ca (Canadian Council of Ministers of the Environment)

http://www.lung.ca (Canadian Lung Association)

http://www.lung.ca/cando/ (Clean Air Now Do It!) (CANDO)

http://www.cmhc-schl.gc.ca (Canadian Mortgage and Housing Corporation)

http://www.hc-sc.gc.ca/ehp/ehd/catalogue/general/iyh/smog.htm (Smog and Your Health)

http://www.ec.gc.ca/air/introduction_e.cfm (Environment Canada - Clean Air)

http://www.hc-sc.gc.ca/hecs-sesc/hecs/climate/welcome.htm (Climate Change and Health Office)

http://www.epa.gov/oar/oarhome.html (Office of Air and Radiation, Environmental Protection Agency, US)

http://www.epa.gov/otaq/ (Office of Transportation and Air Quality, Environmental Protection Agency, US)

Chapter 4 Asthma

Introduction

Asthma is a chronic health disorder affecting a substantial proportion of children and adults worldwide. It is characterised by symptoms of cough, shortness of breath, chest tightness and wheeze. Asthma symptoms and attacks (episodes of more severe shortness of breath) usually occur after exposure to allergens, viral respiratory infections ["colds"], exercise or exposure to irritant fumes or gases. These exposures cause both an inflammation of the airway wall and abnormal narrowing of the airways, which lead to asthma symptoms. Effective treatment can prevent the onset of symptoms in response to these triggers, and can control symptoms once they occur.

Risk Factors

On the basis of longitudinal studies, susceptibility for asthma among children appears to be determined during fetal development and in the first 3 to 5 years of life. Possible risk factors for the development of asthma include[1]:

- Family history of allergy and allergic disorders (including hay fever, asthma and eczema);
- High exposure of susceptible children to airborne allergens (pets, house dust mites, cockroaches, mould) in the first years of life;
- Exposure to tobacco smoke, including in utero exposure;
- Frequent respiratory infections early in life; and
- Low birthweight and respiratory distress syndrome (RDS).[2]

Among adults, the onset of asthma may result from occupational exposures[3,4] to low molecular weight sensitizers such as isocyanates, or following concurrent exposure to infectious agents, allergens and pollution. Atmospheric pollution is not likely a sufficient factor in the primary causation of asthma by itself; instead, most evidence suggests that air pollution is a trigger for worsening asthma. Other possible risk factors among women include smoking and obesity.[5]

Prevalence

The 1998/99 National Population Health Survey (NPHS) found that the prevalence of physician-diagnosed asthma is 8.4% overall: 7.5% among adults (1.629 million Canadians) and 10.7% among children and teens (0.845 million). Prevalence of physician-diagnosed asthma was higher among young boys than girls, but the reverse was the case among adult women and men (Table 4-1). The true prevalence of asthma may differ from estimates provided in population surveys that rely on self-reporting of physician-diagnosed asthma, however, because some individuals with asthma may not yet have been diagnosed while others may be misdiagnosed.

According to the 1996/97 NPHS Asthma Supplement Survey, over one-half of individuals with active asthma had frequent asthma symptoms (wheezing, shortness of breath or fatigue) either daily (14%) or several times a month (37%). As well, 56% reported that they had had an asthma attack in the past 12 months. An asthma attack can be a frightening event with feelings of suffocation, breathlessness, and loss of control, and can be potentially life-threatening.

Table 4-1 Prevalence of physician-diagnosed asthma by age and sex, Canada, 1998/99

Age (Years)	Physician-Diagnosed Asthma					
	Male		Female		Total	
Children	%	Estimated # of Canadians	%	Estimated # of Canadians	%	Estimated # of Canadians
0-19	11.4	461,200	10.0	384,000	10.7	845,100
0-9	10.7	201,400	7.5	138,400	9.1	339,700
10-14	13.5	145,000	10.2*	94,400	11.9	239,400
15-19	10.6*	114,800	14.3	151,200	12.4	266,000
Adults						
20 +	6.5	689,200	8.5	940,100	7.5	1,629,300
20-44	7.7	441,400	9.2	527,100	8.4	968,500
45-64	4.7	155,400	8.4	282,500	6.6	437,800
65+	6.1	92,400	6.6	130,500	6.4	222,900
All Ages	7.9	1,150,400	8.9	1,324,000	8.4	2,474,400

*High sampling variability.

Note: Numbers and percentages are weighted. Numbers are rounded to the nearest 100.

Source: Statistics Canada, National Population Health Survey, Health Share File.

Table 4-2 Prevalence of physician-diagnosed asthma among Canadians by age group and sex, Canada, 1994/95, 1996/97 and 1998/99

Sex/Age (Years)	1994/95**		1996/97		1998/99	
Girls/Women	%	95% CI	%	95% CI	%	95% CI
0-9			8.1*	4.9 - 11.2	7.5	5.2 - 9.8
10-14	11.5*	6.5 - 16.4	12.3	9.0 - 15.5	10.2*	6.1 - 14.2
15-19	13.3	9.6 - 17.0	14.9	11.8 - 18.0	14.3	10.9 - 17.7
20-44	6.7	5.8 - 7.7	8.5	7.6 - 9.4	9.2	8.0 - 10.3
45-64	5.3	4.2 - 6.4	7.0	6.1 - 8.0	8.4	6.5 - 10.3
65+	4.6	3.3 - 5.8	6.0	4.9 - 7.1	6.6	5.2 - 8.1
Boys/Men						
0-9			13.3	9.4 - 17.1	10.7	7.8 - 13.7
10-14	13.5*	8.5 - 18.4	13.4	9.9 - 16.9	13.5	9.6 - 17.4
15-19	10.6	7.2 - 14.0	13.2	10.1 - 16.9	10.6*	7.1 - 14.0
20-44	5.8	4.6 - 6.9	5.5	4.8 - 6.2	7.7	6.4 - 8.9
45-64	4.3	3.1 - 5.5	3.7	2.8 - 4.6	4.7	3.4 - 6.0
65+	5.3	3.4 - 6.9	5.7	4.3 - 7.0	6.1	4.2 - 7.9

*High sampling variability **1994 NPHS includes ages 12+ only CI = confidence interval

Figure 4-1 Prevalence of physician-diagnosed asthma among children by age group, Canada, 1994/95, 1996/97 and 1998/99.

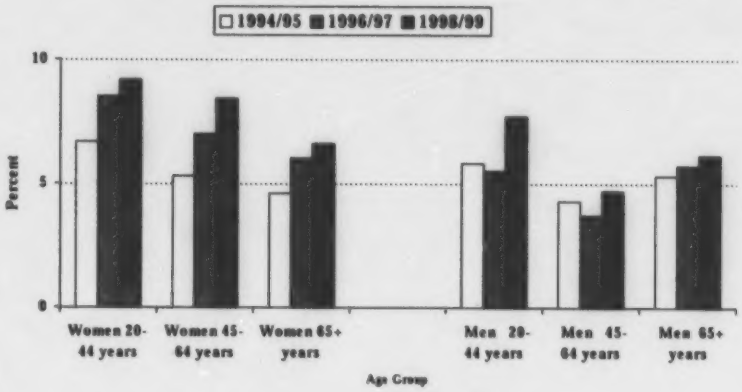
Notes: *High sampling variability due to small sample size.
**1994/95 survey only included children 12 to 14.

Source: Centre for Chronic Disease Prevention and Control, Health Canada, using data from National Population Health Survey, Statistics Canada.

Millar and Hill reported that the prevalence of asthma among children aged 0 to 14 years increased from 2.5% to 11.2 % between 1978 and 1995.[6] According to the NPHS, this increase seems to have levelled off. The prevalence in this age group was 11.5% in 1996/97 and 10.1% in 1998/99 (Figure 4-1) (Table 4-2).

Between 1994/95 to 1998/99, the prevalence of physician-diagnosed asthma increased by 37% among women in the 20-44 year age group and 58% among women aged from 45-64 years. Prevalence also increased by 33% among men in the 20-44 year age group (Figure 4-2) (Table 4-2).

Figure 4-2 Prevalence of physician-diagnosed asthma among adults by age group, Canada, 1994/95, 1996/97 and 1998/99.



Source: Centre for Chronic Disease Prevention and Control, Health Canada, using data from National Population Health Survey, Statistics Canada.

Use of Health Services

Visits to Physicians

Asthma serves as the catalyst for a great number of physician visits in a year. The 1996/97 NPHS Asthma Supplement Survey found that 43% of individuals with current asthma visited their doctors one to three times in the previous year and 17% visited four or more times because of problems with their asthma. The Glaxo Wellcome survey in 1999 found that 43% of asthmatics made unscheduled visits to their physicians for asthma.[7] Of those who visited a doctor for their asthma during the 12 months preceding the survey, over three-quarters (81%) visited the family doctor. Other physicians who were seen included paediatricians (42% of ages 2-19); respirologists or internists (19%); and allergists (13%).

Emergency Visits

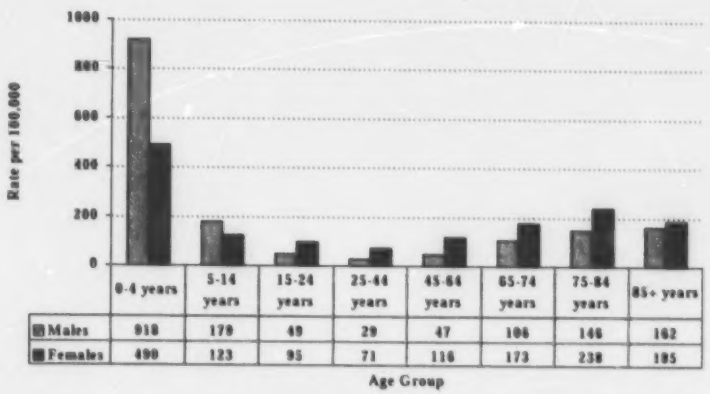
Visits to emergency rooms may be a sign of poorly controlled asthma. The NPHS Asthma Supplement survey found that 18% of individuals with active asthma had visited the emergency department at least once in the past year. The Glaxo Wellcome survey found that 28% had visited the emergency department in the previous year.

Hospitalizations

Asthma continues to be a major cause of hospitalization for children in Canada.[8] Asthma, when listed as one of the top five reasons for admission, contributed to 12% of all admissions in the 0-4 years age group and 10% of all admissions in the 5-14 years age group in 1997. The number of hospitalizations due to asthma may be a more serious sign of poor disease control. According to the NPHS Asthma Supplement, 5.3% of those diagnosed with asthma in Canada require hospitalization each year. The Glaxo Wellcome survey found that 7% of individuals with asthma had been admitted to hospital in the previous year.

Children less than 5 years of age had the highest hospitalization rates for asthma in 1998. Rates among boys were higher than girls in the under-15 age group, but this reversed in older age groups (Figure 4-3). Hospitalization rates among middle-aged women were over twice those of middle-aged men.

Figure 4-3 Asthma hospitalization rates (per 100,000) by age group and sex, Canada, 1998/99.



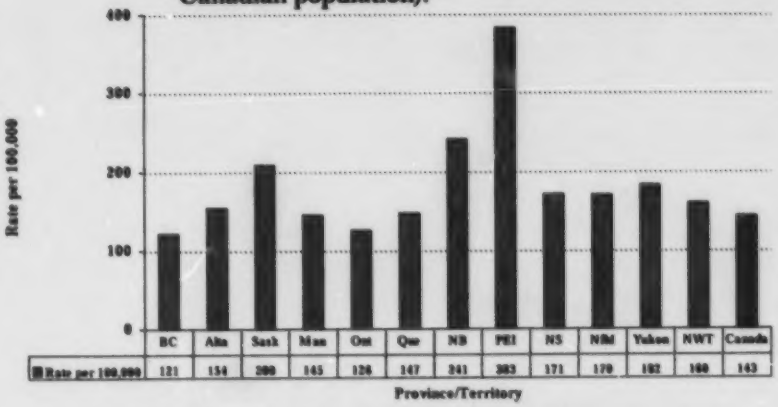
	0-4 years	5-14 years	15-24 years	25-44 years	45-64 years	65-74 years	75-84 years	85+ years
Males	918	179	49	29	47	106	146	162
Females	490	123	95	71	116	173	238	195

Age Group

Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

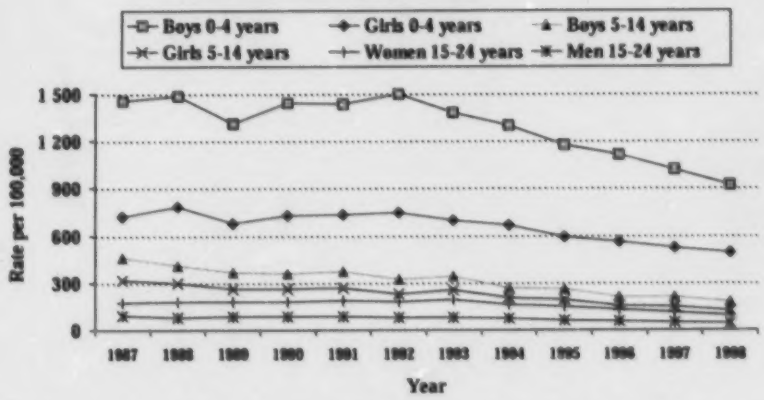
Hospitalization rates varied widely by province in 1996-98. New Brunswick, P.E.I. and Saskatchewan had the highest rates (Figure 4-4).

Figure 4-4 Asthma hospitalization rates (per 100,000) by province/territory, Canada, 1996/97-1998/99 (three-year average) (age/sex-standardized to 1991 Canadian population).



Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

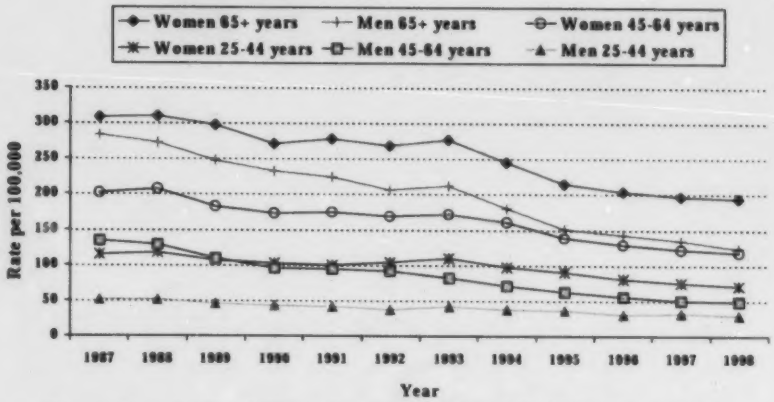
Figure 4-5 Asthma hospitalization rates (per 100,000) in the younger age groups by age and sex, Canada excluding territories, 1987/88-1998/99 (standardized to 1991 Canadian population).



Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

Hospitalization rates for asthma among children and young adults decreased between 1987 and the late 1990s (Figure 4-5). The more recent decline in asthma hospitalization rates may reflect improved disease control. Downsizing in the hospital sector with reduced availability of beds, however, may also be influencing some of the observed changes.

Figure 4-6 Asthma hospital separation rates (per 100,000) among older adults by age group and sex, Canada excluding territories, 1987/88-1998/99 (standardized to 1991 Canadian population).

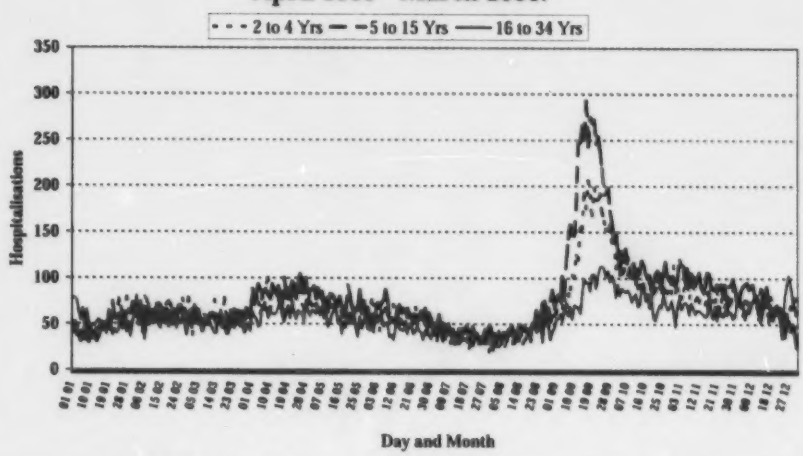


Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

Among older adults, hospitalization rates have also decreased since 1987. This is especially evident among those over 65 years of age (Figure 4-6).

The admissions for asthma vary during the course of the year. Admissions peak during the third week in September for all age groups. The cause for this phenomenon is unknown at this time (Figure 4-7).

Figure 4-7 Number of hospitalisations by day of year and age group, Canada excluding Québec, April 1995 - March 2000.



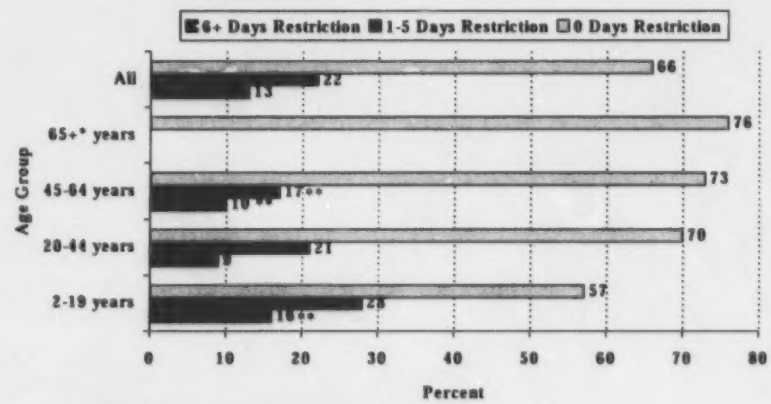
(Source: Neil Johnston, Firestone Research Institute, Hamilton, Ontario)

Health Outcomes

Personal Impact of Asthma

Poor asthma control often results in time away from school, work, sports or other activities that affect quality of life. According to the 1996-97 NPHS Asthma Supplement, 35% of individuals with current asthma had been restricted by asthma in their daily activities – 22% for 1 to 5 days and 13% for more than 5 days in the previous year (Figure 4-8). Similar results were found in the Glaxo Wellcome 1999 survey - 39% reported limitation in their physical activity and 20% absenteeism from school, work or social engagements due to asthma.

Figure 4-8 Proportion of individuals diagnosed with current asthma who had activity restriction in past year, Canada, 1997.

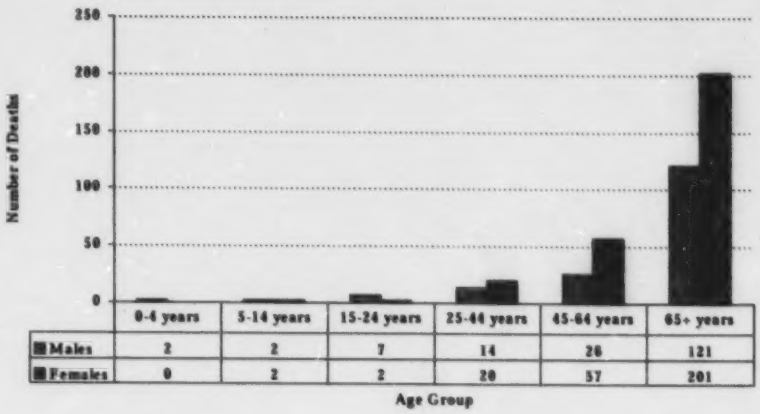


* Sample size was too small for estimate for 65+ age group.
**High sampling variability for all age groups due to small sample size.
Source: Centre for Chronic Disease Prevention and Control, Health Canada, using data from National Population Health Survey Asthma Supplement, Statistics Canada.

Deaths

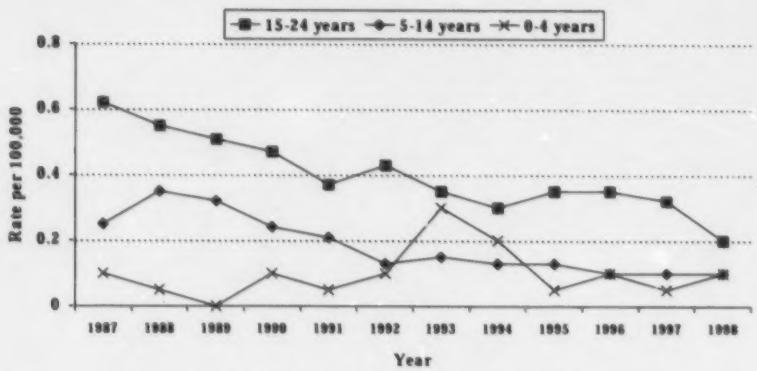
Although deaths from asthma among children and young adults are uncommon, even one is unacceptable for a disease that is fully treatable. The higher number of deaths among women over age 65 reflects the higher asthma mortality rate among women and the higher number of women in this age group in comparison to men (Figures 4-9 and 4-11).

Figure 4-9 Asthma deaths by age group and sex, Canada, 1998.



Source: Centre for Chronic Disease Prevention and Control , Health Canada,using Statistics Canada Mortality Database.

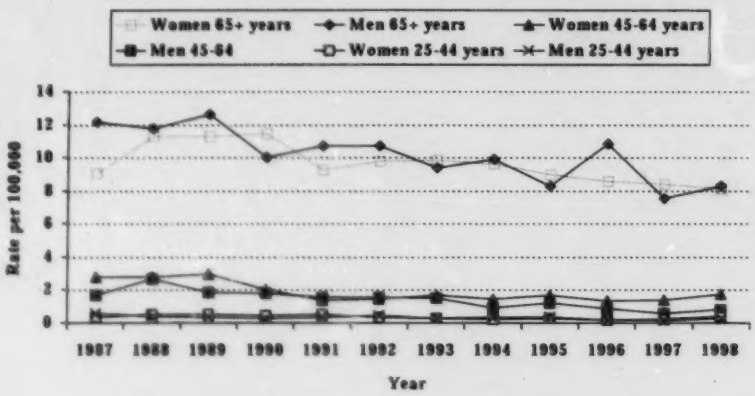
Figure 4-10 Asthma mortality rates (per 100,000) for children and young adults by age group, both sexes, Canada, 1987-1998 (standardized to the 1991 Canadian population).



Source: Centre for Chronic Disease Prevention and Control, Health Canada, using Statistics Canada Mortality Database.

Asthma mortality rates have been decreasing in the 5-14 and 15-24 year-old age groups since 1987. The low number of deaths in the 0-4 age group creates instability in the rates over time (Figure 4-10).

Figure 4-11 Asthma mortality rates (per 100,000) for adults by age group and sex, Canada, 1987-1998 (standardized to the 1991 Canadian population).

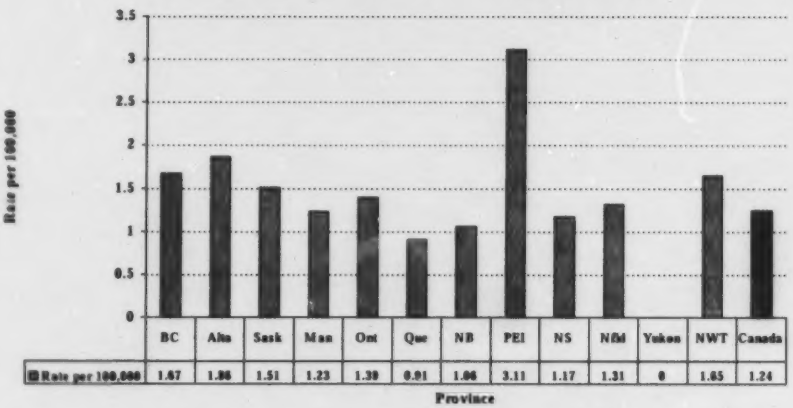


Source: Centre for Chronic Disease Prevention and Control, Health Canada, using Statistics Canada Mortality Database.

Asthma mortality rates have declined among adults during the 1990s. In the 65+ age group, the mortality rate has tended to decrease. The same trend appears in the 45-64 year-old age group. Mortality rates are twice as high among women as men in this age group (Figure 4-11).

In 1996-98, asthma death rates varied widely by province. P.E.I. reported the highest rate and Quebec had the lowest (Figure 4-12).

Figure 4-12 Standardized asthma mortality rates by province, Canada, 1996-1998 (three-year average) (age/sex-standardized to 1991 Canadian population).



Rate per 100,000	BC	Alta	Sask	Man	Ont	Que	NB	PEI	NS	Nfld	Yukon	NWT	Canada
	1.67	1.86	1.51	1.23	1.39	0.91	1.06	3.11	1.17	1.31	0	1.65	1.24

Source: Centre for Chronic Disease Prevention and Control, Health Canada, using Statistics Canada Mortality Database.

Discussion and Implications

While asthma is often considered a "children's disease", it is common among all age groups of Canadians. Children and teens do have the highest prevalence of asthma and the highest hospitalization rates. In terms of number of people affected, however, it actually affects more adults than children. The prevalence among adults is increasing and is cause for concern. Further research is needed to identify the potential factors responsible for increased prevalence rates, as well as to study the primary prevention of asthma in at risk individuals.

Gender appears to be a factor in the prevalence of physician-diagnosed asthma. It is more common among young boys than girls and among more women than men. Among adults, this could be a function of the difference in healthcare-seeking behaviours between men and women: women visit their physicians more often and, therefore, may be more likely to be diagnosed. However, a true difference may be due to the effect of smaller airways in women, hormonal influences and variable sensitivity to irritants and allergens.

The data on activity restriction, emergency room visits and hospitalization suggest that many individuals with asthma do not have their disease under sufficient control. According to the Glaxo Wellcome study, 57% of individuals with asthma are poorly controlled. They do not achieve acceptable levels of control on at least two key criteria of the national guidelines for the treatment of asthma in Canada. One critical factor in improving control is the appropriate use of Asthma Practice Guidelines by physicians. A 1996 Canadian survey of physicians found inconsistencies in the use of the guidelines for diagnosis, use of appropriate medication, self-management plans, education and follow-up.[9] An ongoing, well-funded formal process for educating service providers in the implementation of clinical practice guidelines would not only ensure the correct and timely diagnosis of asthma but also provide a stronger foundation for its management.

Another critical element for effective control is the active involvement of the individual with asthma and his/her family. Many asthmatics need more help in utilizing management strategies such as asthma action plans.[10] Adequate training of asthma educators, funding for asthma education, and ensuring access to this service could improve the effective control of symptoms and the appropriate use of health services by individuals with asthma.

Reducing exposure to airborne school and workplace contaminants, environmental tobacco smoke, house dust mites, animal dander and moulds may decrease the risk of the development of asthma among sensitive individuals. It may also decrease symptoms and attacks among those with asthma. While individuals can take personal responsibility for some preventive measures, other solutions require the collaborative efforts of government, industry and business sectors. Legislation, policies and voluntary co-operation need to be part of a concerted effort to decrease school and workplace contaminants and improve air quality.

The current asthma surveillance system in Canada provides ongoing data on prevalence, hospitalization and death. While one-time population surveys provide additional information, they lack continuity, making it difficult to assess progress in asthma prevention and management. The addition of ongoing population surveys combined with improved use of administrative databases would provide more meaningful information to policy makers.

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[6] Millar WJ, Hill GB. Childhood asthma. Health Reports. Statistics Canada 1998, Winter; 10:3:12.

[7] Glaxo Wellcome Inc. Asthma in Canada: A Landmark Survey, 2000.

[8] Millar WJ, Hill JB. Childhood asthma. Health Report 1998;10:3:9-21.

[9] National Asthma Control Task Force. The Prevention and Management of Asthma in Canada. Health Canada, 2000.

[10] Ibid.

Chapter 5 COPD

Introduction

Chronic obstructive pulmonary disease (COPD) is a chronic disease with shortness of breath, cough and sputum production.[1] Its symptoms do not usually become apparent until age 55. The changes to the lung, however, actually begin many years earlier. Chronic bronchitis and emphysema are the two most common underlying processes that contribute to COPD.

COPD progresses slowly over a period of years and is irreversible, often resulting in death. As the disease progresses, individuals with COPD experience a reduced quality of life due to limited activity levels caused by an increase in shortness of breath. Their families also face two challenges: first, of providing an increasing level of care; and second, watching the relentless progression of the disease in their loved one. The costs associated with COPD - loss in productivity and the need for additional services - affect the family, the health care system and the community as a whole.

Risk Factors

Several modifiable risk factors contribute to COPD.[2] In 80 to 90% of cases, cigarette smoking is the underlying cause of COPD. Occupational exposure to dusts and some fumes (e.g. cadmium, gold dust, coal dust, grain dust) is the other major risk factor. Exposure to non-specific dust is likely to add to the effect of smoking. Outdoor air pollution may increase the risk of COPD, and research has shown an association with increased symptoms, including shortness of breath. Repeated childhood respiratory tract infections and exposure to environmental tobacco smoke (ETS) lead to reduced levels of respiratory function, and this may predispose to eventual COPD. A genetic deficiency of alpha-1-antitrypsin, which protects the lung tissue from being damaged, is also associated with an increased risk of COPD.

Prevalence

According to the National Population Health Survey (NPHS) of 1998/99, 3.2% of the adult population over the age of 34 years [2.8% of men (211,900 Canadians) and 3.6% of women (286,600 Canadians)] stated that they had chronic bronchitis or emphysema that had been diagnosed by a health professional. Unfortunately, since many individuals do not recognize the early symptoms of this disease, they do not seek treatment. Consequently, these figures may under-represent the actual prevalence of COPD in the population. In addition, the diagnostic challenges in differentiating between asthma and COPD among older smokers may result in the misclassification of one disease as the other. As a result, data for the older age groups must be interpreted with caution.

Table 5-1 Prevalence of chronic bronchitis or emphysema (COPD) (diagnosed by a health professional), Canada, 1998/99

Age Group	Physician-Diagnosed COPD					
	Men		Women		Total	
Years	%	Estimated # of Canadians	%	Estimated # of Canadians	%	Estimated # of Canadians
35-54	1.6*	75,700	2.3	106,200	1.9	181,900
55-74	4.0	89,300	5.1	124,400	4.6	213,700
75+	7.8*	46,800	6.3*	56,000	6.9	102,900
All (35+)	**2.8**	211,900	**3.6**	286,600	**3.2**	498,400

* High sampling variability.

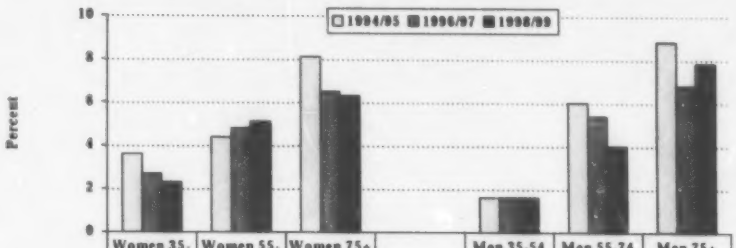
Note: Numbers and percentages are weighted. Numbers are rounded to the nearest 100.

Source: Statistics Canada, National Population Health Survey, Health Share File.

The proportion of individuals diagnosed with chronic bronchitis or emphysema increases with age. In 1998/99, a higher proportion of women than men under the age of 75 years had been diagnosed with these two diseases; this trend reversed, however, in the 75+ age group (Table 5-1). Higher prevalence of smoking among men 50 years ago contributes to the gender difference among the older age group. The higher prevalence of COPD among younger women may reflect the greater sensitivity of women to the harmful components of tobacco smoke.[3] It may also reflect differences between the health care-seeking behaviours of men and women. Women tend to visit their physicians more often than men and, therefore, may be diagnosed earlier with COPD.

Between 1994/95 and 1998/99, the prevalence of physician-diagnosed COPD decreased among women in the 35 to 54 age group (Figure 5-1 and Table 5-2). Prevalence among men remained steady in the youngest age group, and appears to be decreasing among men aged between 55 and 74 years. The high sampling variability among the older age groups of men and women make it difficult to interpret the change in prevalence of COPD in this time frame. Future survey results will help to clarify the trend.

Figure 5-1 Prevalence of physician-diagnosed chronic bronchitis and emphysema adults by age group, Canada, 1994/95, 1996/97 and 1998/99.



	Women 35-54 years	Women 55-74 years	Women 75+ years	Men 35-54 years	Men 55-74 years	Men 75+ years
1994/95	3.6	4.4	8.1 *	1.6 *	6	8.8
1996/97	2.7	4.8	6.5	1.6	5.4	6.8 *
1998/99	2.3	5.1	6.3 *	1.6 *	4	7.8 *

Age Group

*High sampling variability

Source: Centre for Chronic Disease Prevention and Control, Health Canada, using data from National Population Health Survey, Statistics Canada.

The increase in prevalence among women in the middle years may coincide with the increase in smoking rates among women in the post-World War II years. By the same token, the decrease in reported COPD among men in general and among younger women may reflect the decrease in smoking rates that started among both men and women in the 1970s.

Table 5-2 Prevalence of physician-diagnosed chronic bronchitis and emphysema among adults by age group, Canada, 1994/95, 1996/97 and 1998/99

Age (years)	1994/95		1996/97		1998/99	
Women	%	95% CI*	%	95% CI	%	95% CI
35-54	3.6	2.8 - 4.4	2.7	2.2 - 3.2	2.3	1.7 - 2.8
55-74	4.4	3.3 - 5.6	4.8	3.7 - 5.8	5.1	3.8 - 6.5
75+	**8.1	5.2 - 11.0	6.5	4.4 - 8.6	**6.3	3.8 - 8.8
Men						
35-54	**1.6	1.0 - 2.2	1.6	1.2 - 2.0	**1.6	1.0 - 2.2
55-74	6.0	4.5 - 7.4	5.4	4.3 - 6.6	4.0	2.7 - 5.2
75+	8.8	5.0 - 12.6	**6.8	4.5 - 9.1	**7.8	4.9 - 10.6

*CI 95th percent confidence interval **High sampling variability

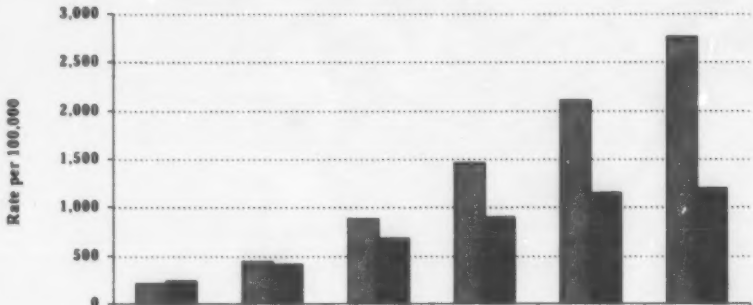
Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from National Population Health Survey, Statistics Canada.

Hospitalization

Hospitalization may be required in the treatment of COPD, particularly when symptoms worsen from infection. In 1997, the average length of stay in hospital for COPD was 10.5 days.

Beginning at age 55 years, hospitalization rates for COPD in 1998 increased steadily with age among both men and women. Rates were higher for men than women particularly among the elderly. This is consistent with the higher smoking rates among men 40 to 50 years ago (Figure 5-2).

Figure 5-2 Chronic obstructive pulmonary disease hospitalization rates (per 100,000) by age group and sex, Canada, 1998/99.



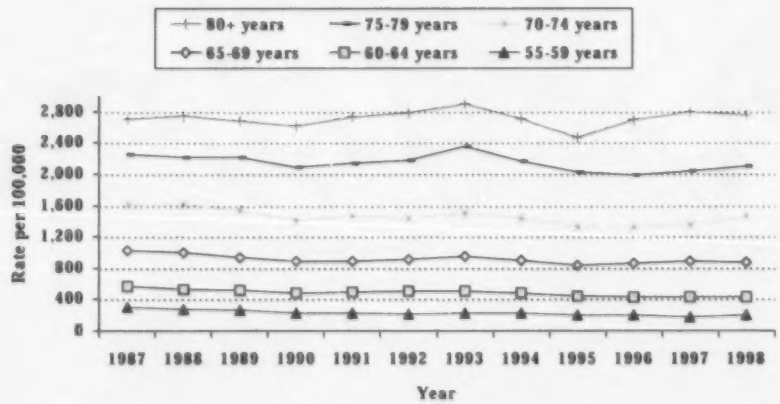
	55-59 years	60-64 years	65-69 years	70-74 years	75-79 years	80+ years
Men	207	435	875	1,465	2,101	2,765
Women	236	412	674	900	1,147	1,197

Age Group

Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

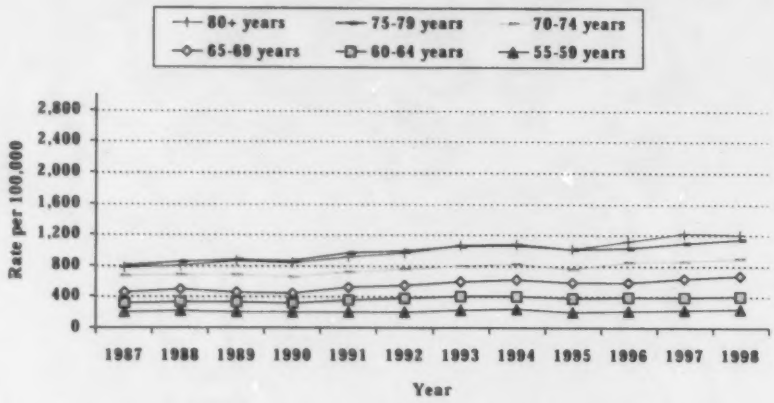
With the exception of older men hospitalization rates among each age group of men decreased slightly during the 1980s and 1990s (Figure 5-3). The change to more community-based care in the delivery of health services may have contributed to this trend.

Figure 5-3 Chronic obstructive pulmonary disease hospitalization rates (per 100,000) for men by age, Canada excluding territories, 1987/88-1998/99.



Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

Figure 5-4 Chronic obstructive pulmonary disease hospitalization rates (per 100,000) for women by age, Canada excluding territories, 1987/88-1998/99.

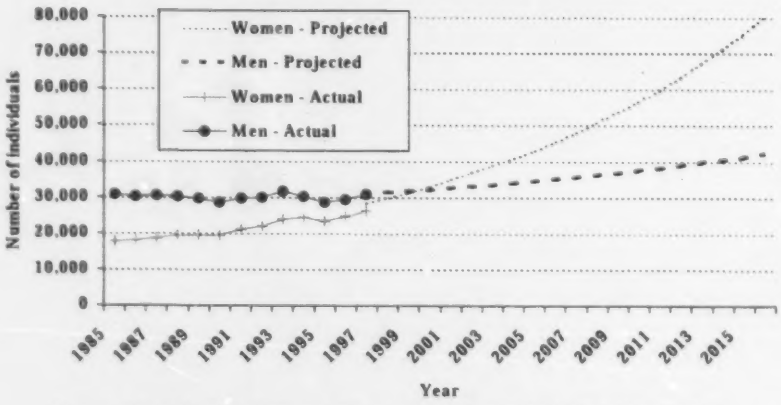


Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

In contrast to the men, hospitalization rates for COPD increased among women in all age groups between 1987 and 1998. This increase may reflect the increase in smoking among women in the past (Figure 5-4).

The number of women hospitalized with COPD increased in the 1990s, a trend that is expected to continue at a high rate (Figure 5-5). While the hospitalization rates for COPD among men have been decreasing (see Figure 5-3), the numbers have been increasing because of the increase in the numbers of seniors in the population over time. The projected increase in hospitalizations for women is higher than for men due to the higher proportion of women in the older age groups. (See Figure 5-1.)

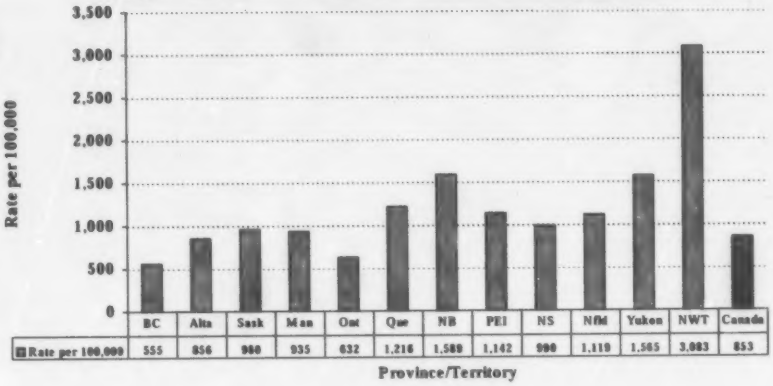
Figure 5-5 Number of individuals hospitalized with chronic obstructive pulmonary disease actual and projected, Canada excluding territories, 1985-2016.



Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information. Population projections from Statistics Canada.

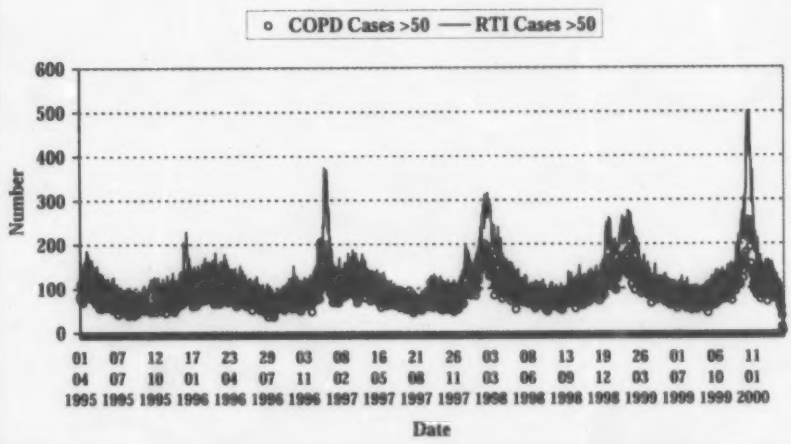
In 1998, Ontario and B.C. had the lowest hospitalization rates for COPD among adults aged 55+ years. The rates are highest in the eastern provinces, Quebec and northern Canada (Figure 5-6). The variation in hospitalization rates among provinces may reflect variations not only in prevalence, but also in the way health services are delivered.

Figure 5-6 Chronic obstructive pulmonary disease hospitalization rates (per 100,000) for adults aged 55+ years by province/ territory, Canada, 1996/97-1998/99 (three-year average) (age/sex-standardized to 1991 Canadian population).



Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

Figure 5-7 Number of hospitalisations for COPD and respiratory tract infections among men and women aged 50 years of age and over by date, Canada excluding Quebec, April 1995 to March 2000.



Source: Neil Johnston Firestone Institute, Hamilton, Ontario.

Hospitalizations for COPD peak in mid-winter and are linked to hospitalizations for respiratory tract infections among men and women over the age of 50 years (Figure 5-7).

Home Care

COPD is a chronic disease with a progressive loss of function. Therefore, individuals with COPD need home care services to enhance their quality of life and decrease the need for hospitalization. Overall, 10.9% of individuals with COPD received home care services in the preceding 12 months according to the National Population Health Survey, 1998/99. The highest use is among those aged 75+ years (29.7%)*.

Activity Restriction

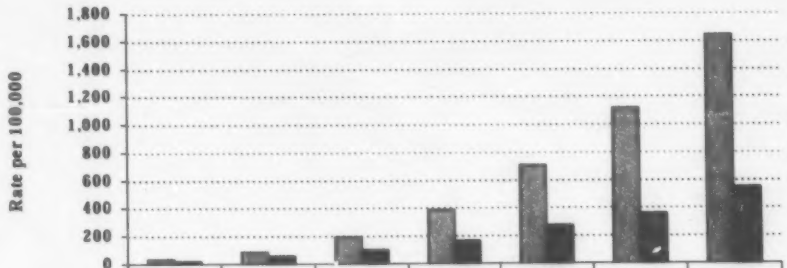
Individuals with COPD face a progressive deterioration in the quality of their lives. According to the 1998/99 NPHS, 51% of individuals with COPD reported that the disease caused a restriction in their activity at home, at work, or in other activities. About 12%* identified COPD as the cause of this restriction. This has important implications for rehabilitation programs.

Mortality

In 1998, COPD accounted for 5,398 deaths among men and 3,643 among women - 4% of all deaths in Canada. The actual mortality rate may be higher because the primary cause of death may be listed as pneumonia or congestive heart failure, with COPD listed on the death certificate as the underlying cause. Since the National Mortality Database does not capture the underlying cause of death, these COPD cases will not be included in the COPD mortality statistics.

In 1998, mortality rates due to COPD increased sharply after age 70 years. Rates were higher for men than women in all older age groups (Figure 5-8). This difference reflects the higher rate of smoking among men 50 years ago.

Figure 5-8 Chronic obstructive pulmonary disease mortality rates (per 100,000) by age and sex, Canada, 1998.



	60-64 years	65-69 years	70-74 years	75-79 years	80-84 years	85-89 years	90+ years
Men	35.1	89.2	197.2	385.5	708.2	1118.1	1642.9
Women	22.8	58.4	100.1	164.9	273.5	358.4	550.8

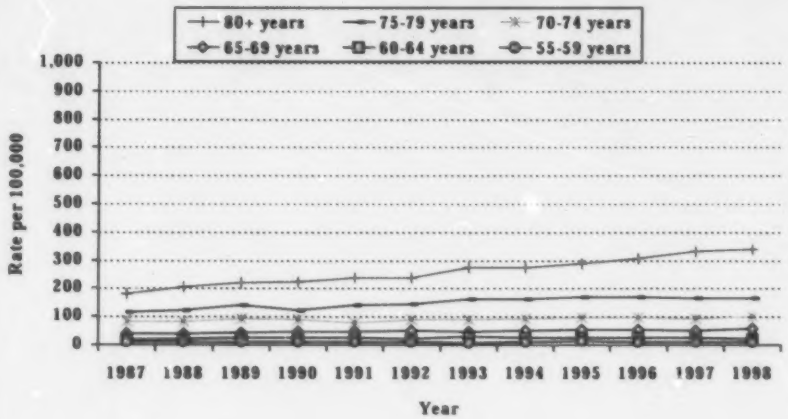
Age Group

Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

*High sampling variability.

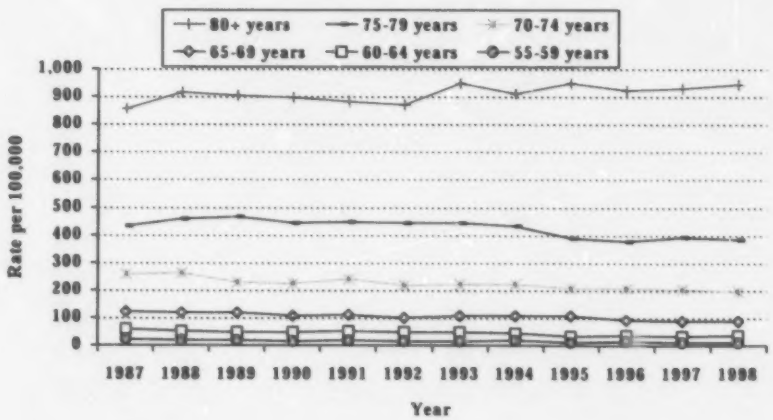
Mortality rates due to COPD among older women increased between 1987 and 1998, particularly for women over the age of 80 years. A similar increase occurred among men over the age of 80 years; however, rates in all other age groups of men tended to decrease slightly (Figures 5-9 and 5-10).

Figure 5-9 Chronic obstructive pulmonary disease mortality rates (per 100,000), women by age, Canada, 1987-1998.



Source: Centre for Chronic Disease Prevention and Control, Health Canada, Statistics Canada.

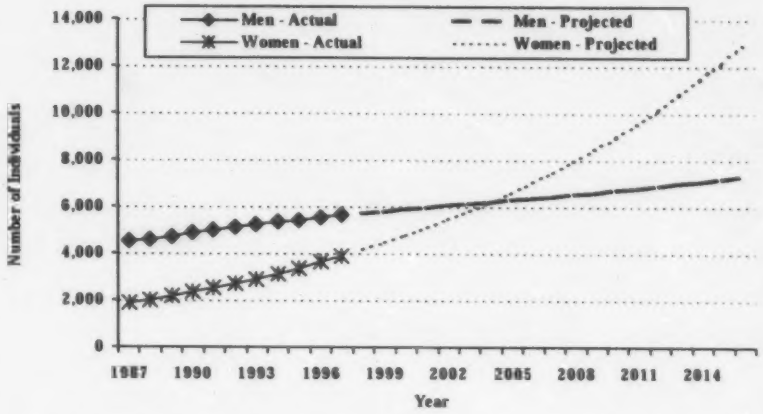
Figure 5-10 Chronic obstructive pulmonary disease mortality rates (per 100,000), men by age, Canada, 1987-1998.



Source: Centre for Chronic Disease Prevention and Control, Health Canada, Statistics Canada.

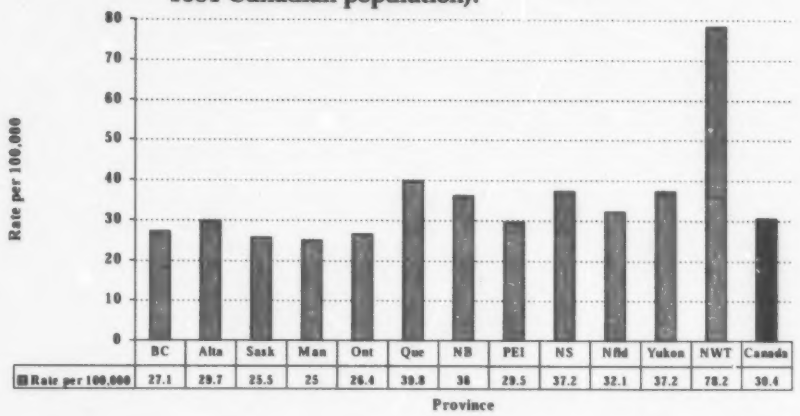
The shift in the population's age structure with more individuals over age 65 will likely result in a continued increase in deaths due to COPD (Figure 5-11). Increasing mortality rates due to COPD among women compared to men, combined with the higher proportion of women among seniors, will produce a steeper rate of increase among women.

Figure 5-11 Number of chronic obstructive pulmonary disease deaths, actual and projected, Canada, 1987-2016.



Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Mortality Database, Statistics Canada. Population projections from Statistics Canada.

Figure 5-12 Chronic obstructive pulmonary disease mortality rates (per 100,000) by province/territory, Canada, 1996-1998 (three year average) (age/sex standardized to 1991 Canadian population).



Source: Centre for Chronic Disease Prevention and Control, Health Canada, Statistics Canada.

In 1996-1998, mortality rates due to COPD were highest in Quebec and most of the eastern provinces (Figure 5-12).

Discussion and Implications

COPD continues to be a common and important health problem among seniors in Canada. The number of individuals with COPD will likely increase in the future as the population ages. Tackling this challenge will require a strong co-ordinated response by government, health care providers, volunteer organizations, patient advocacy groups and community organizations.

While in the past COPD has been considered primarily a man's disease, in 1998/99 more women than men had been diagnosed with COPD. This trend will continue and with it will come major implications for families and the health care system. Since a high proportion of older women live alone, the need for home care, supportive housing and other community services will increase.

The greatest gains in preventing COPD lie in smoking prevention and cessation. (See also Chapter 2.) Smoking prevention presents a significant challenge given the recent increase in smoking rates among young people. Cessation of smoking after COPD is diagnosed has a major impact on slowing the progression of the disease, adding many years back into an individual's life. Greater investment in smoking cessation programs that include behaviour modification strategies and long-term follow-up will increase the probability that the potential gains can be achieved.

Improving both indoor and outdoor air quality would eliminate several factors that exacerbate symptoms of COPD. (See Chapter 3.) Meeting the challenge of improving indoor quality, especially associated with environmental tobacco smoke, will require more legislation and enforcement in order to decrease exposure in the workplace and in public places in the community.

The management of COPD involves the early diagnosis and treatment of symptoms, such as shortness of breath and cough. It also requires efforts to slow the progression of the disease and optimize functional ability.[4] Involvement of the individual and family in all aspects of care is essential to improve health outcomes. Programs and services, such as home care, home oxygen, support housing and pulmonary rehabilitation, provided in a supportive community environment, can meet the unique needs of individuals with COPD and their families.

The increase in the number of people with COPD will require the expansion of existing services in primary care, emergency, hospitalization, specialist care, pulmonary rehabilitation, home care and home oxygen use, and supportive housing. Providing the optimal level of rehabilitation services in the community will be a particular challenge. Currently, these services are primarily hospital-based. In the future, they will require an increase in funding levels and the re-organization of delivery methods, locations and providers.

Monitoring COPD more effectively in the population will require a more comprehensive surveillance system. While the data from the NPHS survey give some sense of the number of people who have been diagnosed with COPD, it misses those who are unaware they have COPD. A population survey that included assessing lung function with spirometry would provide a more complete picture of the prevalence of COPD in the population. In addition, data on the use of health services other than hospital services, such as home care, oxygen therapy and pulmonary rehabilitation, would provide fuller information for identifying the need for new or enhanced programs and services. Finally, population surveys to assess the impact of the disease and the quality of life of those with COPD would add another dimension to the data on health outcomes.

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Chapter 6 Lung Cancer

Introduction

Lung cancer is the leading cause of death due to cancer in Canada. It contributes to approximately 30% of cancer deaths among men and 20% among women. Treatment for lung cancer consists of various combinations of surgical resection, chemotherapy and radiotherapy. Five-year survival rates are quite high (70+%) for individuals with localized non-small cell lung cancer tumours. Unfortunately, only a small proportion of lung cancer is localized at the time of diagnosis. Prognosis for individuals with small cell lung cancers is poor but radiotherapy can alleviate pain due to metastases. No tests or techniques currently exist for the detection of lung cancer at an early enough stage for intervention to improve the course of the disease. Therefore, screening is not a useful strategy for lung cancer prevention and control.

Risk Factors

Smoking

Cigarette smoking is the predominate cause of lung cancer. It accounts for at least 80% of all new cases of lung cancer in women and 90% in men.[1] Risk rises sharply with an increase in number of cigarettes smoked per day, and more so with an increase in number of years of smoking.[2,3] Quitting smoking can reduce the risk of lung cancer.[4]

A few recent studies explored the hypothesis of an elevated risk of lung cancer among those who start smoking earlier in life, independent of duration and amount smoked. The evidence is conflicting.[5,6] Further research is required to better understand this possible link.

Pipe and cigar smoking are also linked to lung cancer but each carries smaller risks than for cigarette smoking, possibly due to different inhalation patterns.[7]

Environmental Factors

Environmental tobacco smoke (ETS) is one of the major risk factor for lung cancer among non-smokers since human carcinogens are present in tobacco smoke that is inhaled by bystanders.[8] Several occupational exposures have also shown an association with an increased risk of cancer.[9] Such hazards include asbestos (shipyard and construction workers, miners), arsenic (vineyard workers, sheep dip, goldmines, smelters), polycyclic aromatic hydrocarbons (generating plants, steelworkers), chromate and chromium (industry workers, chromium platers), silica (steel founding), mustard gas manufacturing, nickel refining, and uranium mining. Occupational exposure to radon and radon daughter products increases lung cancer risk. Domestic levels of these carcinogens in households may also elevate lung cancer risk, though findings have not been definitive.

Other factors such as air pollution and prior lung disease are suspected to be determinants of risk. Motor vehicle exhausts and industrial emission releases of polycyclic aromatic hydrocarbons are known to be carcinogenic. Persons with a history of non-malignant lung disease could also be prone to an increased risk of lung cancer.

Nutrition

The risk of lung cancer can be decreased through a high intake of fresh vegetables and fruits.[10,11,12] Individuals with a high consumption of fresh vegetables and fruits have about one-half the risk of individuals with much lower consumption.[13] The strongest evidence supports consumption of carrots and green vegetables.[14] A review of studies that relate specific nutrients to risk of lung cancer indicates that high carotenoid consumption probably leads to a decreased risk and that diets high in vitamins C and E are possibly protective.[15,16]

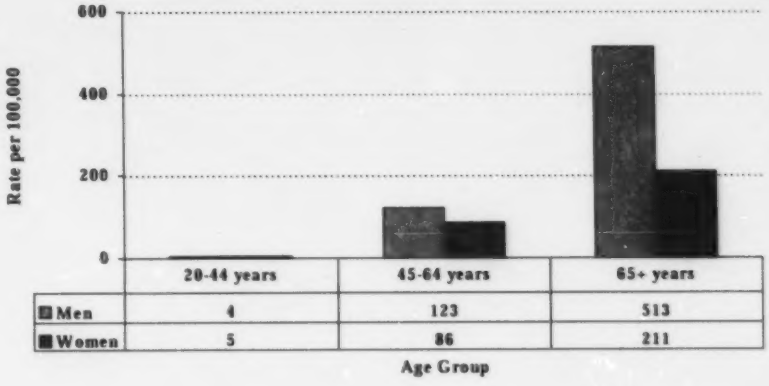
Some studies support the hypothesis that a high cholesterol and/or high fat diet, particularly saturated fat, increases the risk of lung cancer, though this support is inconsistent.[17,18,19] Several others have associated alcohol consumption with an increased risk of lung cancer, although these studies do not rule out the possibility that the observed effect may be the result of residual confounding by cigarette consumption.[20]

Incidence

In 1997, 18,518 Canadians developed lung cancer: 11,203 men and 7,315 women.* Sixty-five percent of new cases were among individuals aged 65 years and over, 32% among those aged 45-64 years, and 3% of those under age 45 years.

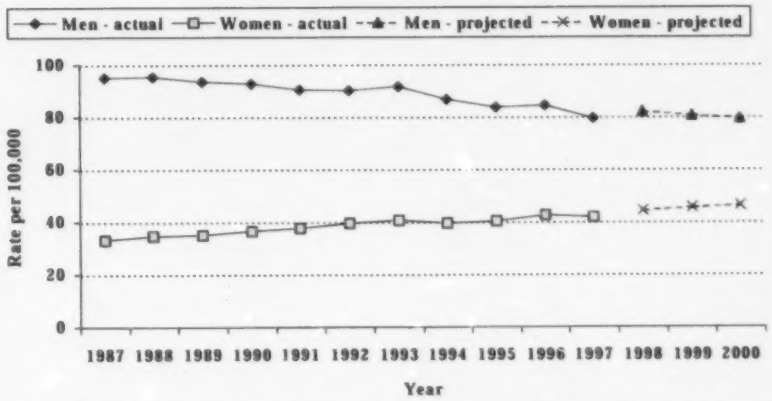
In 1997, incidence of lung cancer among men aged 65+ years was 2.4 times the rate among women in the same age group. Although the rate in the 45-64 years age group was also higher among men, the ratio of men to women was only 1.4 to 1 (Figure 6-1).

Figure 6-1 Incidence rates (per 100,000) of lung cancer by age group and sex, Canada, 1997.



Source: Centre for Chronic Disease Prevention and Control, Health Canada with data from the Canadian Cancer Registry, Statistics Canada. The Ontario Cancer Registry provided data for 1997 directly to Health Canada.

Figure 6-2 Incidence rate (per 100,000) of lung cancer by sex, Canada, 1987-2000 (1996+ projected) (age-standardized to 1991 Canadian population).



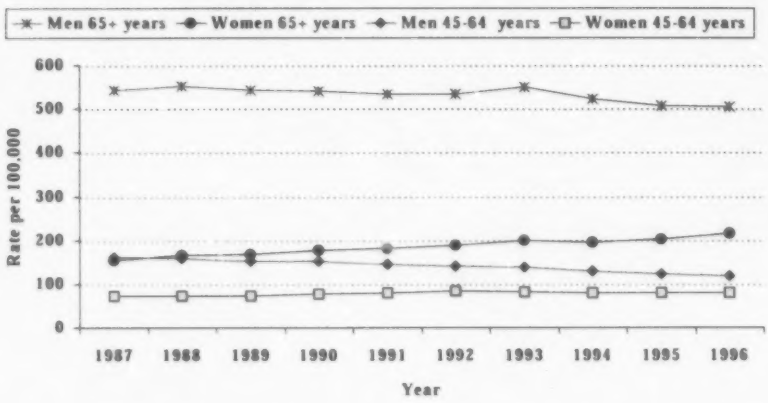
Source: Centre for Chronic Disease Prevention and Control, Health Canada with data from the Canadian Cancer Registry, Statistics Canada. The Ontario Cancer Registry provided data for 1997 and 1998 directly to Health Canada. Population data for projections from Statistics Canada.

Since 1987, the incidence of lung cancer among men has decreased. On the other hand, incidence rates among women have shown a steady increase (Figure 6-2).

* Estimate based on preliminary analysis of the Canadian Cancer Registry.

The reduction in incidence rates has occurred among men in both the 45-64 and 65+ age groups. The increase in incidence rates has been greater among women aged 65+ than among women in the 45-64 age group (Figure 6-3).

Figure 6-3 Incidence rate (per 100,000) of lung cancer by age group and sex, Canada, 1987-1996 (age-standardized to 1991 Canadian population).

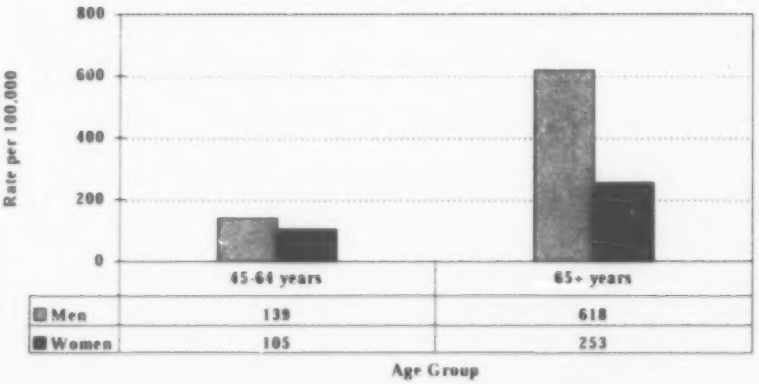


Source: Centre for Chronic Disease Prevention and Control, Health Canada with data from the Canadian Cancer Registry, Statistics Canada.

Hospitalizations

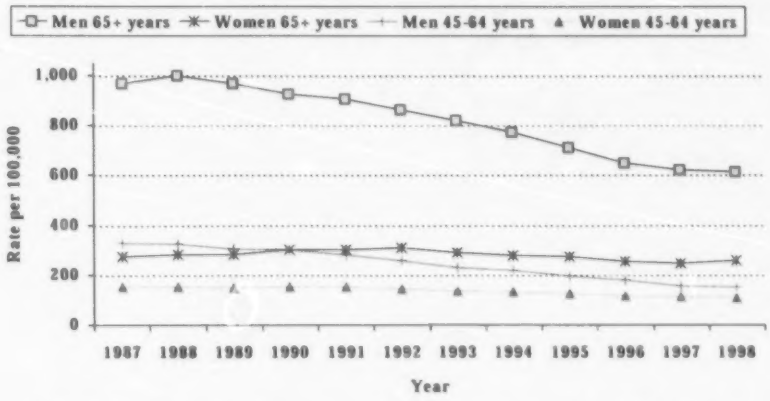
In 1998, hospitalization for lung cancer was greater among individuals aged 65+ than among individuals 45-64 years of age. The rate among men aged 65+ was over two-and-one-half times the rate among women (Figure 6-4).

Figure 6-4 Lung cancer hospitalization rates (per 100,000) by age group and sex, Canada, 1998/99.



Source: Centre for Chronic Disease Prevention and Control, Health Canada, using data from Hospital Morbidity File, Canadian Institute for Health Information.

Figure 6-5 Lung cancer hospitalization rates (per 100,000) by age and sex, Canada excluding territories, 1987/88-1998/99 (age-standardized to 1991 Canadian population).

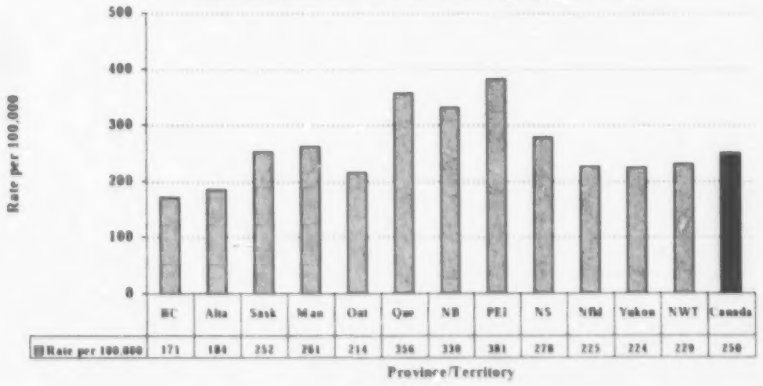


Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

Since 1987, the age-standardized hospitalization rates have shown a major decrease among men aged 45 to 64 years and those over the age of 65 years. Women's rates have decreased slightly in both the 45-64 year-old and 65+ age groups (Figure 6-5).

In 1996-1998, lung cancer hospitalization rates showed a wide variation by province. The highest rates appeared in P.E.I., Quebec and New Brunswick, and these were more than twice the lowest rate in B.C. (Figure 6-6).

Figure 6-6 Lung cancer hospitalization rates (per 100,000) among adults aged 45+ years by province, Canada, 1996/97-1998/99 (three-year average) (age/sex-standardized to 1991 Canadian population).



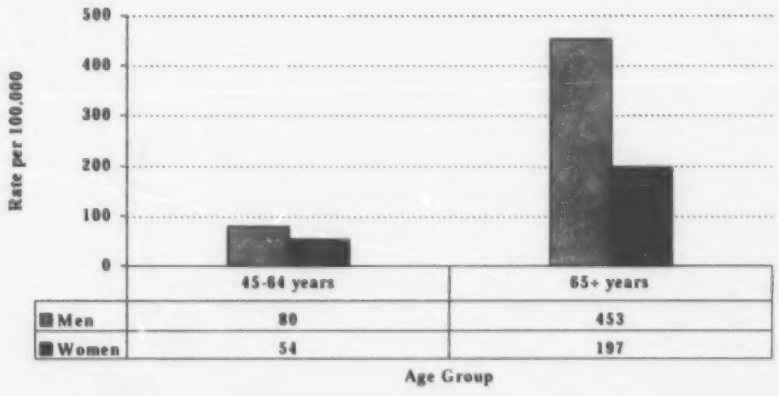
	BC	Alta	Sask	Man	Ont	Que	NB	PEI	NS	Nfld	Yukon	NWT	Canada
Rate per 100,000	171	184	252	261	214	356	330	381	278	225	224	229	250

Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

Mortality

In 1998, 15,438 Canadians died from lung cancer. Deaths due to lung cancer increased dramatically with age, especially among individuals in the 65+ age group. However, 30% of lung cancer deaths still occurred among individuals under the age of 65 years.

Figure 6-7 Lung cancer crude mortality rate (per 100,000) by age group and sex, Canada, 1998.

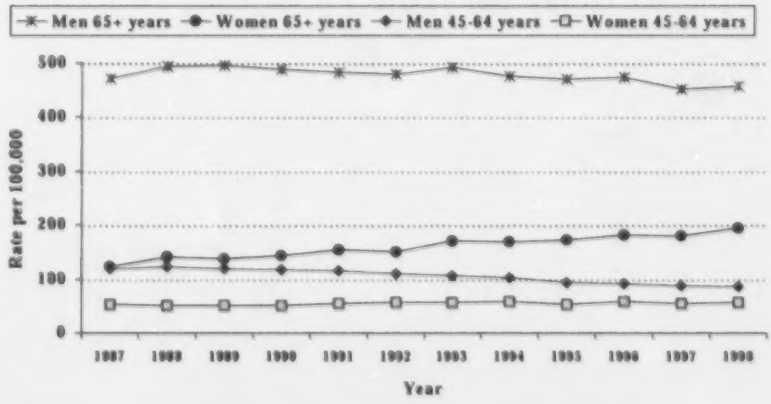


Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from mortality files, Statistics Canada.

The death rate among men in 1998 aged 65+ years was two-and-one-half times the rate for women. In the 45-64 age group, the men-to-women ratio of lung cancer deaths was only 1.6 to 1 (Figure 6-7).

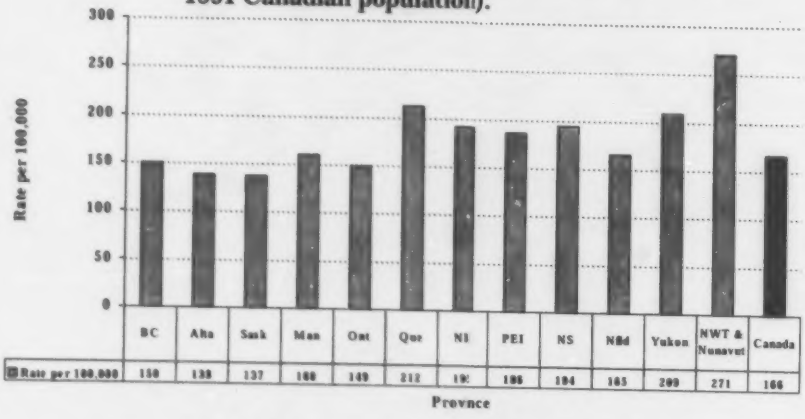
Between 1987 and 1998, the mortality rate due to lung cancer among women aged 65+ years increased, while the rate among women aged 45-64 years remained steady. The mortality rate among men decreased slightly during the same time period (Figure 6-8).

Figure 6-8 Lung cancer mortality rate (per 100,000) by age group and sex, Canada, 1987-1998 (age-standardized to 1991 Canadian population).



Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from mortality files, Statistics Canada.

Figure 6-9 Lung cancer mortality rate (per 100,000) among adults aged 45+ years by province, Canada, 1996-1998 (three-year average) (age/sex-standardized to 1991 Canadian population).



Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from mortality files, Statistics Canada.

Mortality due to lung cancer varied by province in 1996-1998. Quebec, New Brunswick and Nova Scotia had the highest rates, and Saskatchewan the lowest (Figure 6-9).

Discussion and Implications

Lung cancer is rapidly becoming a major health issue for women. Both the incidence and mortality rates among older women are increasing in contrast to the decreases seen among older men. Societal influences that encouraged women to smoke 30 to 40 years ago are now being reflected in these trends.

If any progress is to be made in reducing the incidence of lung cancer, it will be by preventing children and teens from starting to smoke and by encouraging cessation among those who already do smoke. In addition, reducing exposure to environmental tobacco smoke is essential to reducing lung cancer deaths among non-smokers. (See Chapter 2 - Smoking.)

Cancer treatment services are already experencing difficulty in meeting the demand for health care. This will only be exacerbated by the projected increase in incidence of lung cancer among women in the future. This demand will include all aspects of cancer treatment including diagnosis, radiotherapy, chemotherapy, surgery, education and support. It will also place major demands on palliative care services.

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Chapter 7 Infectious Diseases

Introduction

This chapter will discuss the major infectious respiratory diseases in Canada:

- Tuberculosis
- Influenza and Pneumonia
- Respiratory Syncytial Virus (RSV)

Tuberculosis

Tuberculosis (TB) continues to be a major worldwide health problem. In 1993, the World Health Organization (WHO) declared tuberculosis as a "global emergency", the first and only such declaration in its history. It is estimated that the TB bacillus has infected one-third of the world's population. Approximately 8 million new cases of active TB disease develop annually and it results in 2 to 3 million deaths. As a result, tuberculosis is the leading cause of morbidity and mortality due to a single infectious agent. This has important implications for Canada due to international travel and immigration from TB-endemic countries.

Furthermore, the development of drug-resistant strains threatens to return the world to the pre-antibiotic era. Worldwide, approximately 50 million individuals are infected with TB strains resistant to at least one of the first-line anti-tuberculosis drugs. In addition, 1% of the 16 million prevalent cases of active TB disease are multiple-drug resistant (MDR-TB), defined as being resistant to at least isoniazid and rifampin.

After decades of declining rates in Canada, the annual reported incidence of active TB disease levelled off after 1987, leading to concern that this changing trend may herald a resurgence of the disease here. It is estimated that approximately 10% of Canadians have latent TB infection. While these individuals have been infected by the TB bacillus, they are not infectious but could develop active disease at a later point in time.

Risk Factors

The risk factors for tuberculosis can be divided into those that are more likely to lead to TB infection and those more likely to lead to the progression of latent TB infection to active TB disease.

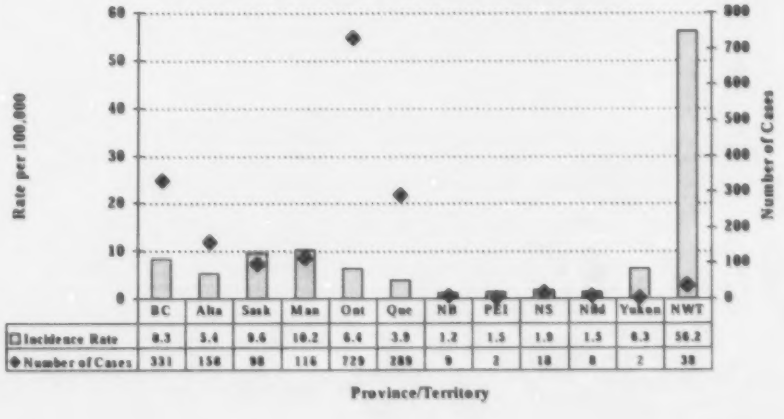
Risk factors for exposure to and subsequent infection with the TB bacillus include being born and living in a country with a much higher rate of tuberculosis compared to Canada, being of Aboriginal origin, living in a disadvantaged inner-city population where conditions such as homelessness and substance abuse are more prevalent, spending time in a correctional facility, and being of older age (and therefore having lived through a period of time when TB was much more prevalent throughout the entire world).

Risk factors for progression to active TB disease among those with latent TB infection include having HIV infection, immunocompromising health conditions such as diabetes, cancer and renal failure, malnutrition, alcohol abuse, long term corticosteroid use, and radiotherapy.

Incidence

In 1998, 1,798 cases of new active and relapsed cases of tuberculosis were reported in Canada (5.9 per 100,000). While Ontario and B.C. reported the largest number of cases, the incidence rates were highest in the Northwest Territories (Figure 7-1).

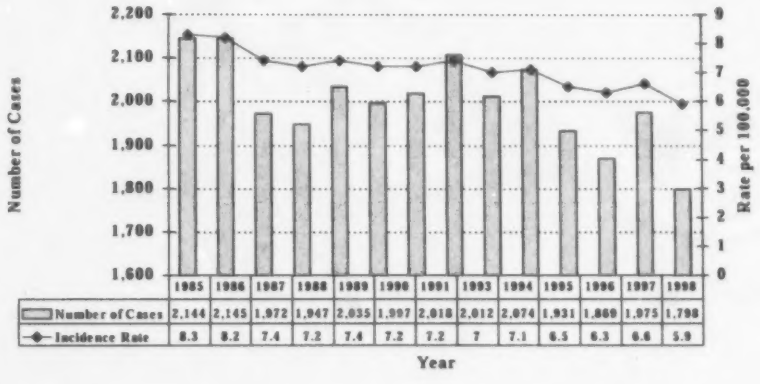
Figure 7-1 Number of cases and incidence rate (per 100,000) of reported new active and relapsed tuberculosis cases by province/territory, Canada, 1998.



	BC	Alta	Sask	Man	Ont	Que	NB	PEI	NS	Nfld	Yukon	NWT
Incidence Rate	8.3	5.4	9.6	10.2	6.4	3.9	1.2	1.5	1.9	1.5	6.3	56.2
Number of Cases	331	158	98	116	729	289	9	2	18	8	2	38

Source: Tuberculosis Prevention and Control, Centre for Infectious Disease Prevention and Control.

Figure 7-2 Number of cases and incidence rate (per 100,000) of reported new active and relapsed tuberculosis cases, Canada, 1985-98.



	1985	1986	1987	1988	1989	1990	1991	1993	1994	1995	1996	1997	1998
Number of Cases	2,144	2,145	1,972	1,947	2,035	1,997	2,018	2,012	2,074	1,931	1,869	1,975	1,798
Incidence Rate	8.3	8.2	7.4	7.2	7.4	7.2	7.2	7	7.1	6.5	6.3	6.6	5.9

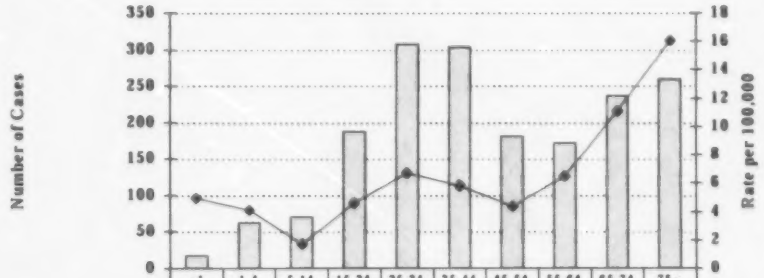
Year

Source: Tuberculosis Prevention and Control, Centre for Infectious Disease Prevention and Control.

Since 1987, the incidence of reported new active and relapsed tuberculosis cases in all of Canada has stabilized (Figure 7-2).

In 1998, the greatest number of reported cases of new active and relapsed tuberculosis was among individuals aged 25 to 44 years. While the number of cases was lower among the oldest age groups, their incidence rates were the highest (Figure 7-3).

Figure 7-3 Number of cases and incidence rate (per 100,000) of reported new active and relapsed tuberculosis cases by age group, Canada, 1998.



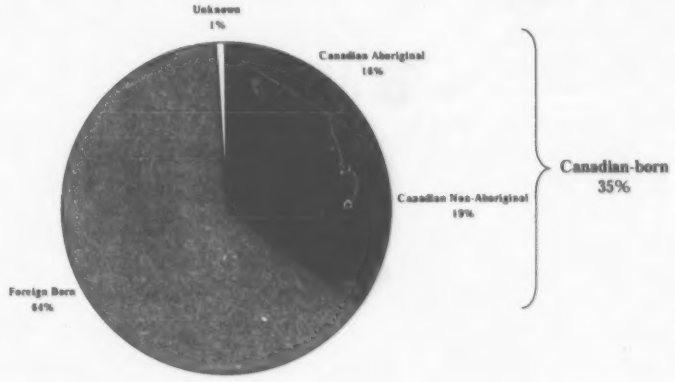
	<1 year	1-4 years	5-14 years	15-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75+ years
Number of Cases	17	63	71	187	308	303	181	172	237	259
Incidence Rate	4.9	4.1	1.7	4.6	6.7	5.8	4.4	6.5	11.1	10.1

Age Group

Source: Tuberculosis Prevention and Control, Centre for Infectious Disease Prevention and Control.

In 1998, nearly two-thirds (64.3%) of new active and relapsed TD cases involved individuals who were born outside of Canada. Of the 1,157 cases who were foreign-born, 569 were from the Western Pacific WHO region (49.2%) (Figure 7-4).

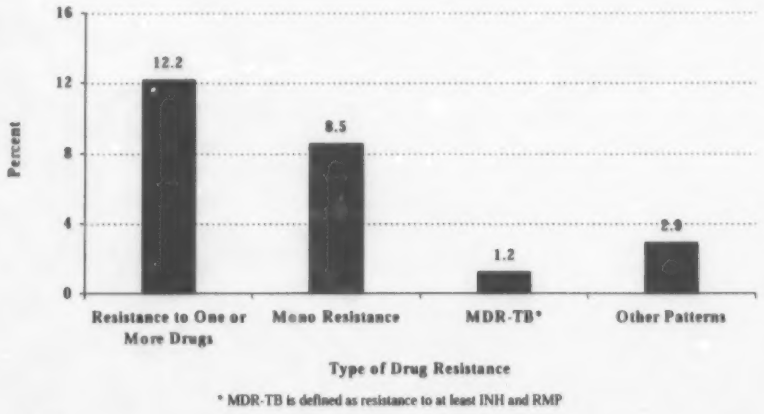
Figure 7-4 Proportion of reported new active and relapsed tuberculosis cases by birthplace, Canada, 1998.



Source: Tuberculosis Prevention and Control, Centre for Infectious Disease Prevention and Control.

In 1999, 1,414 isolates of *Mycobacterium tuberculosis* and *M. tuberculosis complex* were reported across Canada. Of these, 171 (12.2%) were resistant to one or more first-line anti-TB drugw(s). Resistance to ioniazid (INH) was the most common type of drug resistance reported (8.5%). MDR-TB (defined as resistance to at least INH and RMP) accounted for 1.2% of the isolates (Figure 7-5).

Figure 7-5 Overall pattern of reported TB drug resistance in Canada, 1999 (n = 171).



Source: Tuberculosis Prevention and Control, Centre for Infectious Disease Prevention and Control.

Discussion and Implications

A number of reasons underline the potential for a resurgence of tuberculosis in Canada. First, modern jet travel has resulted in increasing and more rapid international movement of people for trade, tourism, immigration and migration. Tuberculosis is transmitted through the air by relatively casual contact. In Canada, the proportion of foreign-born TB cases is increasing, due in large part to the changing immigration patterns to Canada.

The spreading co-epidemic of TB and HIV represents a second major concern. HIV-positive individuals are up to 30 times more likely than HIV-negative individuals to progress to active infectious TB disease from TB infection. Among persons with HIV infection, TB is the leading "opportunistic" disease and cause of death worldwide. It differs from other opportunistic diseases in that it can be transmitted to persons without HIV infection and thus become a problem for the whole community. In Canada, limited data exist on the extent of TB-HIV co-infection. A recent national study found that 4.2% of the cumulative reported AIDS cases to the end of 1996 also had TB.[1] Another national study is underway to examine the extent of known HIV infection among reported TB cases.

The spread of drug-resistant tuberculosis strains throughout the world also represents a threat. In Canada, the latest national surveillance data indicate that over 12% of the reported TB isolates tested in laboratories in 1999 were resistant to one or more of the common first-line anti-tuberculosis drugs. MDR-TB accounted for 1.2% of the tested isolates.

The Canadian Tuberculosis Committee, which includes representation from each provincial/territorial TB control program, the provincial/territorial laboratory directors, Citizenship and Immigration Canada and the Canadian Lung Association, enhances and co-ordinates TB control activities across the country. A national consensus conference organized by the Division of Tuberculosis Prevention and Control in 1997 brought together technical experts from across the country and developed numerous recommendations for a national TB elimination strategy. Specific recommendations were made in a number of key areas, including programming and case management, laboratory, Aboriginal peoples, immigration, TB-HIV and research. The recent release of the fifth edition of the Canadian Tuberculosis Standards, jointly produced by Health Canada and the Canadian Lung Association, will help to improve clinical/public health practices related to tuberculosis among health care/public health professionals.

The continuous monitoring of TB in Canada remains a critical component of an overall TB control strategy. To this end, Health Canada has enhanced national tuberculosis surveillance activities by establishing a laboratory-based system in 1998 and expanding the tuberculosis case reporting system to include data collection on treatment outcomes.

Influenza and Pneumonia

Influenza and pneumonia are the leading cause of death from infectious diseases in Canada and the sixth most common cause of death overall. They account for about 8,000 deaths per year[2], most of which occur in the elderly population. It is estimated that community-acquired pneumonia (CAP) accounts for 1 million doctor visits a year in Canada as well as 60,000 hospitalizations costing about $100 million.[3] National data on the incidence of hospital-acquired infections are unavailable in Canada; in the USA, however, it is believed that pneumonia is the second most common type of infection acquired in hospital (urinary tract infection is the most common), and it is associated with the highest mortality rate.[4]

A large number of infectious agents cause pneumonia. Causal agents vary by age, presence of co-morbidity, severity of pneumonia and locus of acquisition (community versus hospital). Among adults and the elderly, the most frequent causes of CAP include *Streptococcus pneumoniae*, respiratory viruses, *Mycoplasma pneumoniae*, *Chlamydia pneumoniae* and *Haemophilus influenzae*. Influenza virus, the most common viral agent, often precedes secondary bacterial pneumonia. In children under 2 years of age, respiratory syncytial virus (RSV) and other respiratory viruses are the main cause of pneumonia and bronchiolitis. Mixed bacterial and viral infections are often observed in youngsters under the age of 15 years, although the causal agents remain unidentified in about 30 % of the cases.[5,6,7,8]

Individuals at extremes of age (elderly and infants), those with chronic cardio-respiratory disease or immunosuppression (disease or drug therapy) and some specific populations such as Aboriginal peoples are at higher risk for severe lower respiratory tract infections.

Prevention measures for pneumonia and influenza include vaccination with pneumococcal vaccine and influenza vaccine (annually) and the adoption of good hygienic practices.

Incidence of Influenza

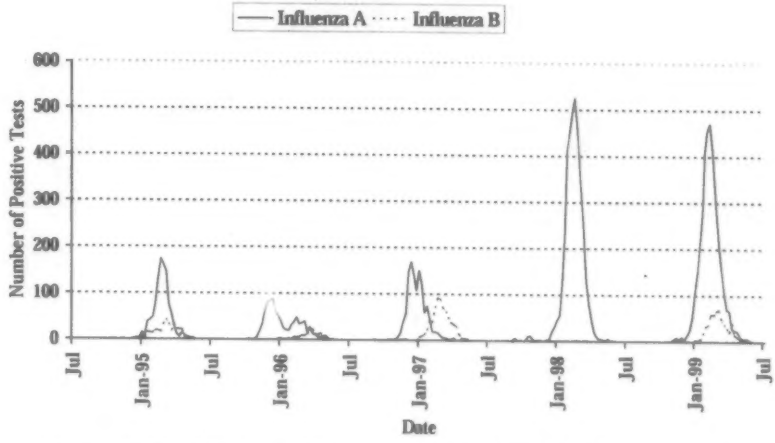
Based on the results of serosurveys, 10 to 20% of the general population[9] are infected by the influenza virus almost every winter. The Centre for Infectious Disease Prevention and Control (CIDPC) maintains a national influenza surveillance program, FluWatch. The objective of FluWatch is to provide a national picture of influenza activity across Canada during the influenza season. This program has three main elements: (1) laboratory-based influenza virus identification, (2) influenza-like illness (ILI) surveillance, and (3) reporting of influenza activity level by provincial and territorial epidemiologists. In addition, FluWatch monitors reports by the United States Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) on influenza activity.

While each component of the FluWatch program has its limitations, they appear to complement each other well. The main limitation of the laboratory system is that specimen collection and submission to the national laboratory are subject to the individual practices of the attending physicians and the availability of the test within and among provinces and territories. The sentinel physician component is limited by the fact that it may not include a representative sample of the population, and it is not specific to influenza but includes any respiratory infection. Finally, the

influenza activity level provided by the provincial or territorial epidemiologists, although based on many indicators, is a subjective assessment.[10]

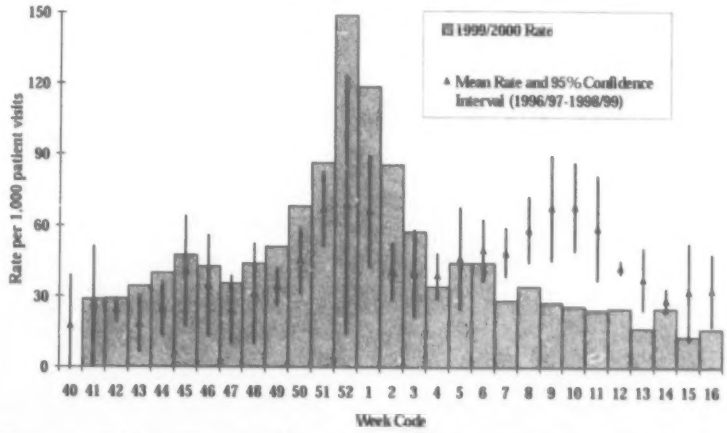
Both influenza type A and type B cause annual epidemics. However, influenza type A epidemics cased by H3N2 viruses are usually often more severe than those caused by Influenza H1N1 and Influenza B viruses.[11] Although regional patterns may vary, influenza illness in Canada usually peaks in January and subsides in late spring (Figure 7-6).

Figure 7-6 Laboratory Confirmed Influenza in Canada, 1994-1999.



Source: FluWatch, Division of Respiratory Diseases, Centre for Infectious Diseases Prevention and Control, Health Canada

Figure 7-7 Comparison of the 1999/2000 influenza-like illness (ILI) rate to the average rate in the three-year period from 1996/97 to 1998/99, Canada.



Source: Division of Respiratory Diseases, Centre for Infectious Diseases Prevention and Control, Health Canada.

The influenza-like-illness (ILI) rate, which is the number of patients with ILI over the total number of patients seen in a day, shows the same pattern of peak influenza activity during December and January (Figure 7-7).

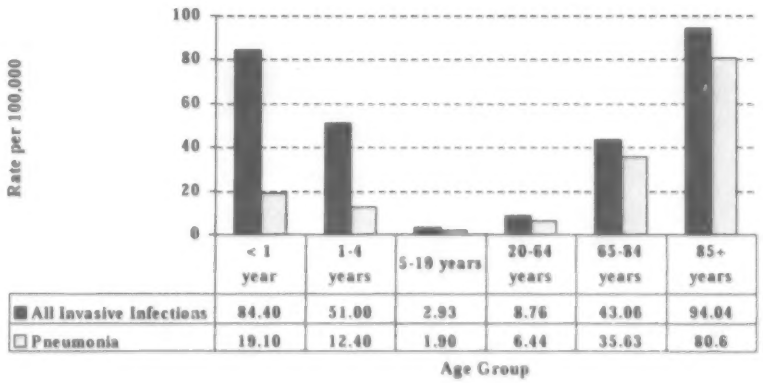
Incidence of Invasive Pneumococcal Disease

Streptococcus pneumoniae, the most common cause of CAP, accounts for about 30 to 50% of cases.[12,13,14] Invasive pneumococcal disease (IPD), which includes primarily bacteremic pneumonia, meningitis, and bacteremia without any focal site, has only been reportable nationally since January 2000. However, a 1996 study in nine health units across Canada found that the overall incidence of IPD was 15.8 per 100,000 population, or approximately 4,500 cases per year in Canada.[15]

This survey was limited to only a 1-year period and the population under observation did not include any of Canada's four largest metropolitan areas. The results were similar to the results of other surveillance systems in Quebec and the Toronto-Peel region in Ontario during the same period.[16,17]

The overall incidence of invasive pneumococcal pneumonia was 10 per 100,000, but was greatest in the young and in the elderly. In the 65+ age group the rate was 33 per 100,000. Among the 85+ age group it was 81 per 100,000 (Figure 7-8). While pneumonia is the main clinical presentation in those 5 years of age and older, meningitis more often affects the less than 5-year age group. Overall case-fatality ratio of IPD was about 11%, and 20% for the 65+ age group.[18]

Figure 7-8 Incidence of *S. pneumoniae* infections by age group, Canada, 1996.

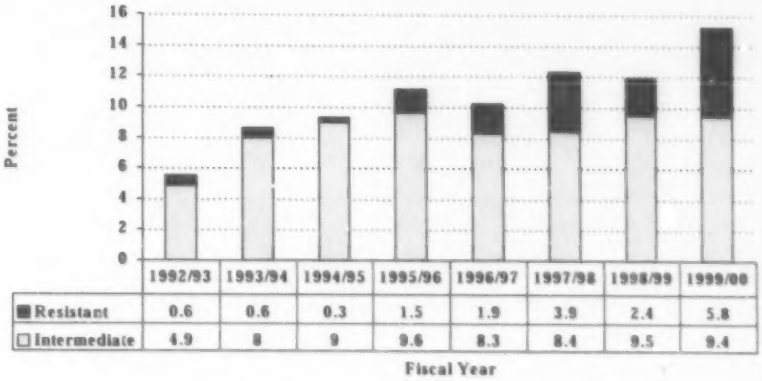


Source: Sentinal Health Unit Surveillance System, Division of Respiratory Diseases, Centre for Infectious Disease Prevention and Control, Health Canada.

Sixty percent of those with IPD were eligible for immunization according to the nationally established criteria. Ninety-two percent of cases of IPD were caused by a few pneumococcal serotypes. Since these same seroptypes are contained in the current 23-valent polysaccharide vaccine, immunization should decrease the incidence of invasive pneumococcal disease.[19,20,21,22]

Resistance to antibiotics is increasing among strains of *S. pneumoniae*.

Figure 7-9 Reduced susceptibility to penicillin for invasive pneumococci in Canada, 1992-2000.



Source: National Centre for Streptococcus, Provincial Laboratory of Public Health for Northern Alberta, Edmonton, Alberta.

Data from the National Centre for Streptococcus (NCS) in Edmonton have shown that the rate of reduced susceptibility to penicillin has increased steadily in the last 7 years, from 5.5% in the fiscal year 1992/1993 to 15.2% in 1999/2000 (Figure 7-9). In the last few years, most of this increase was due to high level of resistance.[23]

Although the sample of isolates tested by NCS is over-represented by IPD cases in Alberta, the IMPACT surveillance system, a paediatric hospital-based surveillance system covering 85% of all tertiary care paediatric beds in Canada, found similar results with a rate of reduced susceptibility to penicillin increasing from 4.1% in 1992 to 13.0% in 1998.[24]

The National Advisory Committee on Immunization (NACI) has recommended pneumococcal vaccine for the elderly and all individuals with health problems that place them at higher risk for serious infection due to *S. pneumoniae*. It became widely used only in the last few years.

Mycoplasma pneumoniae and *Chlamydia pneumoniae*

M. pneumoniae and *C. pneumoniae* are recognized to be common causes of bacterial pneumonia; however, there are no current Canadian data on these agents from etiologic studies or surveillance of pneumonia. Estimates from the United States suggest that about 100,000 and 50,000 patients are hospitalized every year with pneumonia due to *M. pneumoniae* and *C. pneumoniae* respectively.[25] Moreover, recent studies have shown a strong association between *C. pneumoniae* and artherosclerosis vascular disease.[26]

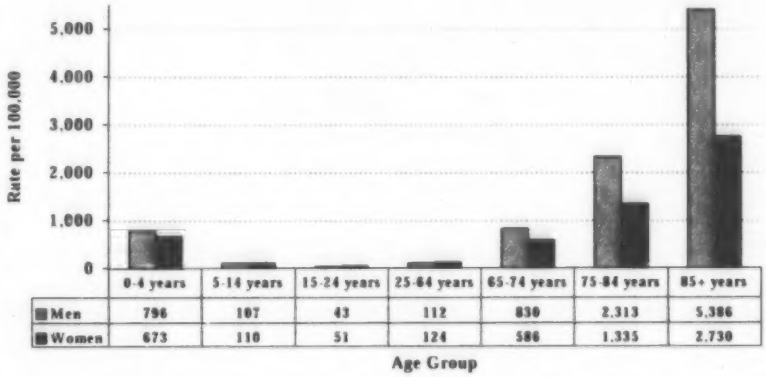
Legionnaire disease

Between 1988 and 1997, a mean number of 80 cases of Legionnaire disease (range: 63-102) have been reported per year in Canada. This likely represents only a small proportion of all cases due to lack of adequate laboratory-based evaluation and under-reporting. About 80% of cases are sporadic, but outbreaks have occurred in hospitals, hotels, cruise ships, etc. The text with it on page 10 should read. The case-fatality ratio is up to 39% in hospitalized cases of Legionnaire disease.[27]

Hospitalizations

Hospitalization rates for influenza and pneumonia increase sharply after age 65 years. Elderly men have a much greater hospitalization rate than women (Figure 7-10).

Figure 7-10 Hospitalization rate (per 100,000) for influenza and pneumonia by age group and sex, Canada, 1998/99.



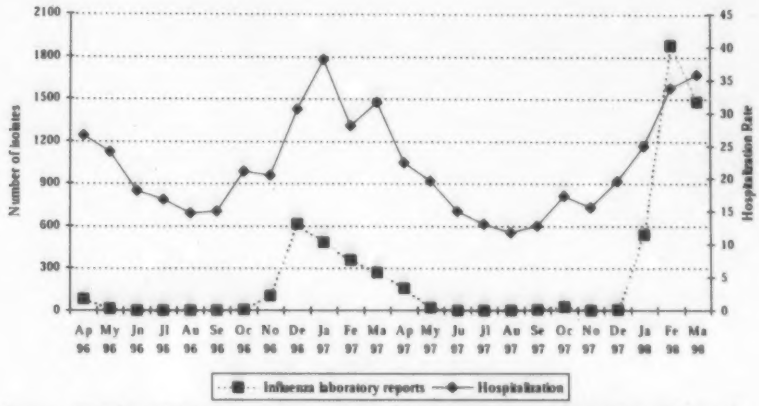
	0-4 years	5-14 years	15-24 years	25-64 years	65-74 years	75-84 years	85+ years
Men	796	107	43	112	830	2,313	5,386
Women	673	110	51	124	586	1,335	2,730

Age Group

Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

F2

Figure 7-11 Influenza laboratory isolates and hospitalization rate (per 100,000) for pneumonia, Canada, 1996-1998.

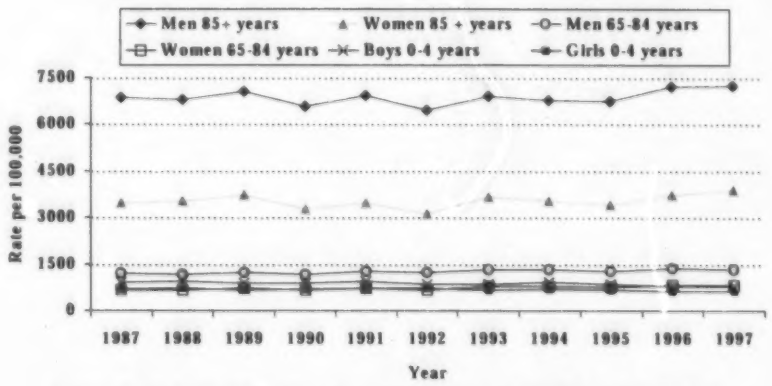


Source: Division of Disease Surveillance, Centre for Infectious Disease Prevention and Control and Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

While hospitalization for pneumonia occurs throughout the year, a sharp increase is observed during peak influenza activity, when many of these pneumonia cases are due to a bacterial infection following influenza infection (Figure 7-11).

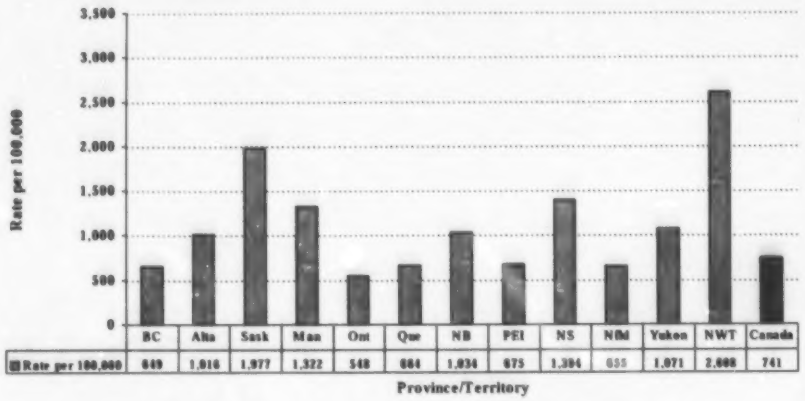
Since 1987, the rates of hospitalization among seniors have shown a slight increase for both men and women. Hospitalization rates for pneumonia among all ages of children have remained steady (Figure 7-12).

Figure 7-12 Hospitalization rate (per 100,000) for influenza and pneumonia among children aged 0-4 years and adults aged 65+ years by age group and sex, Canada excluding territories, 1987-1997 (standardized to 1991 Canadian population).



Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

Figure 7-13 Hospitalization rate (per 100,000) for influenza and pneumonia among children aged 0-4 years by province/territory (three-year average), Canada, 1996-1998.

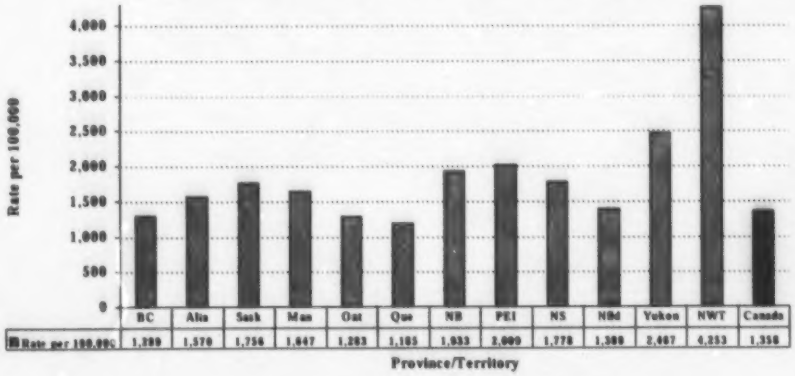


Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

In 1996-98, the highest hospitalization rates for influenza and pneumonia among children aged 0-4 years were in the Northwest Territories and Saskatchewan (Figure 7-13).

Hospitalization rates for pneumonia and influenza among seniors were highest in the Northwest Territories (Figure 7-14).

Figure 7-14 Hospitalization rate (per 100,000) for influenza and pneumonia among adults aged 65+ years by province/territory (three-year average), Canada, 1996-1998 (age/sex standardized to 1991 Canadian population).



Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

Mortality

Deaths due to influenza and pneumonia increase sharply with age. The rate among the 85+ is more than 4 times higher than in 75-85 age group. In all age groups over the age of 65, the mortality rates of men were higher than among women (Figure 7-15).

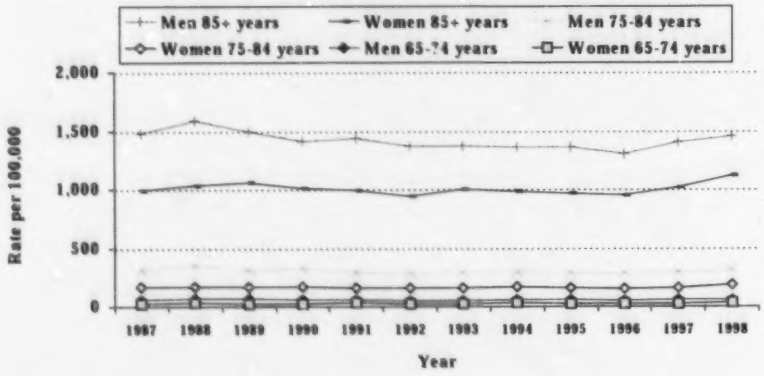
Figure 7-15 Mortality rate (per 100,000) for influenza and pneumonia among adults aged 65+ years by age group and sex, Canada, 1998.

	65-74 years	75-84 years	85+ years
Men	61	312	1452
Women	33	190	1121

Age Group

Source: Centre for Chronic Disease Prevention and Control, Health Canada using Statistics Canada Mortality Database.

Figure 7-16 Mortality rate (per 100,000) for influenza and pneumonia among adults aged 65+ years by age group and sex, Canada, 1987/98-1998/99 (age-standardized to 1991 Canadian population).

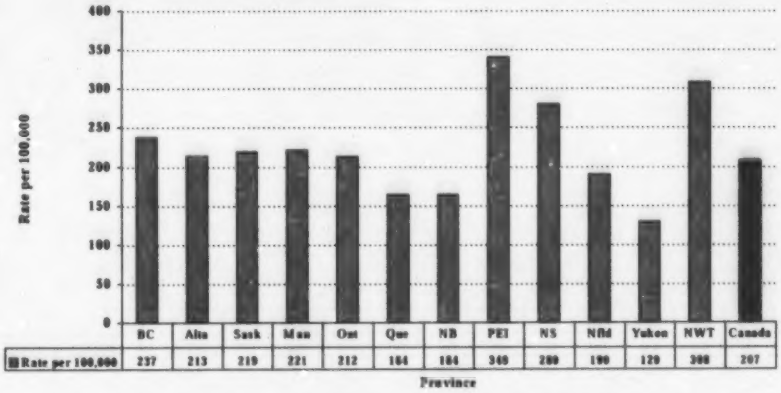


Source: Centre for Chronic Disease Prevention and Control, using data from mortality files, Statistics Canada.

In the latter years of the 1990s, the influenza and pneumonia mortality rate among men and women aged 85+ years has increased, while rates remained stable among all other age groups, for both sexes (Figure 7-16).

Mortality rates due to infuenza and pneumonia were highest in two of the four eastern provinces (P.E.I. and Nova Scotia) and the Northwest Territories (Figure 7-17).

Figure 7-17 Mortality rate (per 100,000) due to influenza and pneumonia among adults aged 65+ years by province, Canada, 1998 (age/sex-standardized to 1991 Canadian population).



Source: Centre for Chronic Disease Prevention and Control, Health Canada, using Statistics Canada Mortality Database.

Discussion and Implications

The FluWatch program appears to provide a comprehensive picture of influenza activity in Canada. The peak of influenza-like illness (ILI) activity corresponds to the peak number and percent positive of specimens received by the laboratory for influenza testing. Hospitalizations due to influenza and pneumonia also increase dramatically during this period. Bacterial pneumonia complicates influenza infection, particularly in high-risk groups such as the elderly. Men have higher rates of hospitalization and mortality due to influenza and pneumonia, most likely related to their higher rates of COPD and cardiac diseases.

Influenza surveillance activities are critical to ensure the early warning of epidemics and pandemics, to identify the circulating influenza virus types and strains, to monitor disease spread and impact, and to evaluate the control programs and interventions. In January 2000, a national meeting on pandemic influenza contingency planning identified four main areas for enhancement: development of mortality surveillance, enhancement of laboratory capacity, enhancement of reporting on vaccine-associated adverse events, and improved reporting of outbreaks and emergency room visits for ILI. A solid surveillance infrastructure should be in place during the inter-pandemic period, together with contingency plans for rapid expansion of surveillance activities when a new pandemic virus emerges.

Overall, 12 of the 13 provinces and territories have publicly funded influenza immunization programs, including all or some of the 11 target groups recommended by the NACI.[28] In the fall of 2000, Ontario became the only province to have a universal influenza publicly funded program for all residents. The Yukon Territory also publicly funds a similar program for those 18 years of age and over and those with high-risk health conditions who are less than 18 years of age. The current activities for planning for pandemic influenza have given influenza a higher profile with increased awareness of influenza and pneumococcal disease prevention programs. This increase in influenza vaccine use will strengthen Canada's public health infrastructure's ability to deliver vaccine and increase national capacity to produce influenza vaccine. It will likely help us to improve our response during a future influenza pandemic.

S. pneumoniae is an important cause of illness, hospitalization and death in Canada and worldwide. Historically, *S. pneumoniae* was uniformly susceptible to penicillin. The incidence of penicillin resistance has been increasing in many areas of the world during the past 2 decades, but it has grown at a greater rate in the past 5 years. The increase in antibiotic resistant *S. pneumoniae* underscores the need for prevention through immunization. Most of the circulating strains are included in the current 23-valent polysaccharide pneumococcal vaccine.

Since January 2000, invasive pneumococcal disease has been under national surveillance. This will provide better information on the burden of illness and the distribution in terms of person, place and time. An enhanced surveillance system that combines more detailed epidemiological data (such as risk groups/factors and immunization status) with laboratory data for the monitoring of serotypes and antimicrobial resistance would help to assess the impact of the immunization program. It would also help in determining the geographic location and in assessing the risk factors related to drug resistance.

The 23-valent polysaccharide pneumococcal vaccine has been available since the 1980s in Canada. NACI recommends vaccination for specified groups at high risk of pneumococcal disease. A survey performed in 2000 revealed that all 13 provinces and territories have publicly-funded pneumococcal programs. In eight of the jurisdictions, the program includes all target groups recommended by NACI. The number of doses of vaccine that have been distributed has increased dramatically since 1996 when Ontario launched a mass catch-up campaign, which was subsequently matched by other provinces. Canada now has the second highest rate of vaccine distributed per capita in the world, following very closely the USA.[29] Distribution of vaccine is used as a proxy for immunization coverage rates. As shown in the Toronto-Peel region (population: 3 million), publicly funded programs for target populations have reduced the incidence of invasive pneumococcal disease in target populations.[30]

M. pneumoniae and *C. pneumoniae* are known to cause significant illness in adults and children. A multi-centre study of etiologies of community-acquired pneumonia on a regular basis in Canada would help to better assess the burden of these diseases and understand their epidemiology. Early recognition of outbreaks due to these agents has been problematic, hampering the prompt initiation of control measures that would prevent the spread of the disease. More sensitive and rapid diagnostic tests have to be developed. In addition, the exact role of *C. pneumoniae* in the development and/or progression of atherosclerosis needs to be determined.

Legionnaire disease is recognized as significantly under-diagnosed and under-reported. Increasing awareness among physicians and applying more sensitive, non-invasive tests such as urine antigen testing has led to improved recognition of sporadic cases and outbreaks. Improved understanding of the ecology of *Legionellae* can increase the effectiveness of prevention and control measures. Since *Legionellae* grow in stagnant water, improved design and maintenance of cooling towers and plumbing systems to limit the growth and the spread of *Legionellae* are of utmost importance. Also, efforts should be undertaken to increase the knowledge of the general public about the proper maintenance of such appliances as humidifiers.

Respiratory Syncytial Virus (RSV)

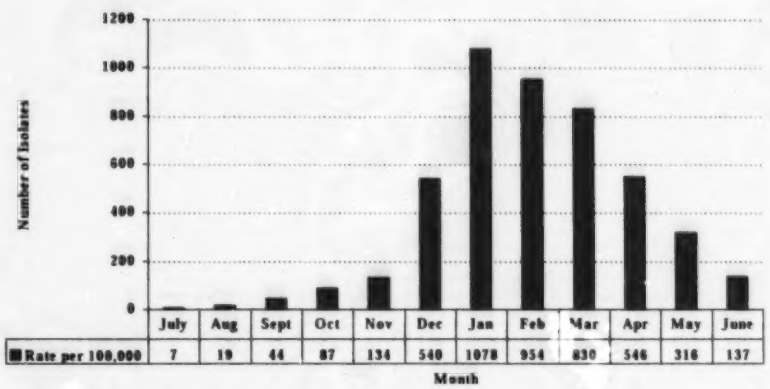
Respiratory syncytial virus (RSV) is the underlying cause of most bronchiolitis and pneumonia in children under 2 years of age. RSV, a common virus, infects nearly all children by age 2 years. For most, the infection is mild, but in a small percentage of cases, the infection is severe enough to require hospitalization.

Risk factors for severe RSV-related disease include very young age (less than 6 months), congenital heart disease, underlying respiratory diseases, preterm birth and immunosuppressive conditions.[31] Environmental factors have also been associated with severe RSV-related disease.[32]

Incidence

No data on the incidence of RSV infections are currently available in Canada. However, Nunavut, the Northwest Territory and Yukon included RSV infections in their list of reportable conditions in 2000. The Respiratory Viral Detection surveillance system consists of a network of about 15 to 20 public health and hospital laboratories across the country. The system assists in describing both geographic and temporal trends of RSV infections in Canada. While it provides a good indication of whether RSV is circulating in a community, the correlation between the lab data and the burden of RSV infections in the population is uncertain.

Figure 7-18 Number of RSV positive laboratory isolates per month, Canada, 1997/98.

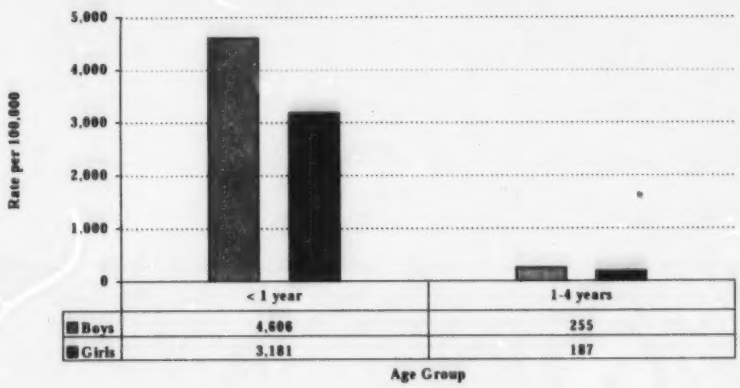


Source: Notifiable Disease Reporting System, Division of Disease Surveillance, Centre for Infectious Disease Prevention and Control, Health Canada.

RSV activity usually starts in the late fall, peaks in early winter and tapers off in the late spring (Figure 7-18).

Hospitalizations for Bronchiolitis

Figure 7-19 Acute bronchiolitis hospitalization rates (per 100,000) among children under 5 years of age by age group and sex, Canada, 1998.

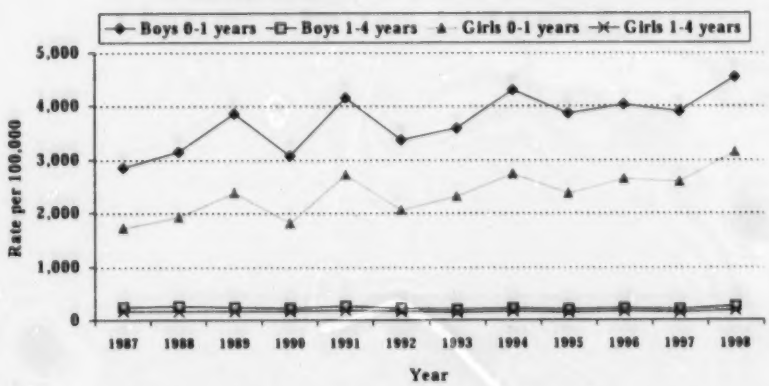


Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

Children under the age of 1 year required the most hospitalizations for bronchiolitis. In 1998, the rate among children under 1 year of age was nearly 20 times that of those between 1 and 4 years of age. Boys had a higher rate of hospitalization than girls (Figure 7-19).

Between 1987 and 1998, hospitalization rates for bronchiolitis increased among infants within the first year of life. The increase among boys was over one-half (55%) and among girls was 45% (Figure 7-20).

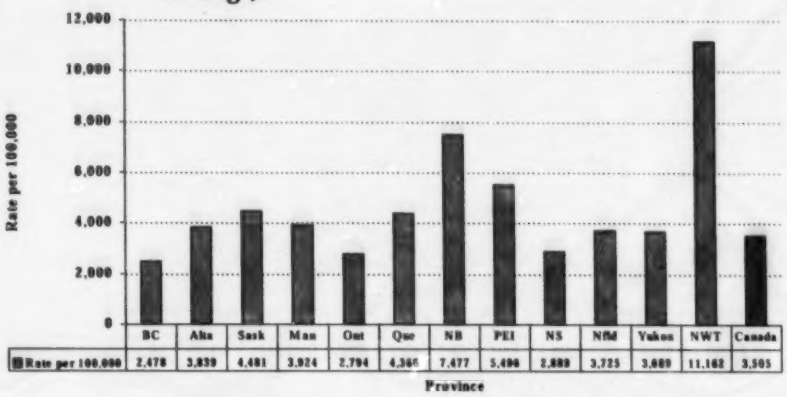
Figure 7-20 Hospitalization rates (per 100,000) for acute bronchiolitis among children 4 years of age and under by age group, Canada excluding territories, 1987/88-1998/99.



Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

In 1996-1998, higher rates of xhospitalization for bronchiolitis among infants were found in New Brunswick, P.E.I. and the Northwest Territories (Figure 7-21).

Figure 7-21 Hospitalization rate (per 100,000) for acute bronchiolitis among infants to age 12 months by province/territory, Canada, 1996-1998 (three-year average).



Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

Inuit children in the Northwest Territories have very high rates of lower respiratory tract infection, often leading to hospitalization and sometimes requiring ventilation because of the severity of the disease.[33]

Discussion and Implications

Male infants have a higher rate of hospitalization and mortality due to RSV infections than do female infants. This may be due to anatomical differences. In comparison to their female counterparts, male infants have smaller airways for their lung size, putting them at increased risk for severe disease when infected by a respiratory virus. This difference diminishes, however, due to the rapid growth experienced in the first year of life.

The bronchiolitis-associated hospitalizations have increased in the last decade. The three most likely causes are the increase in the number of children in child-care centres, the changes in the criteria for hospitalization for lower respiratory tract infection, and increased survival among premature babies and those with important medical conditions that place them at high risk for serious RSV infection.[34]

Surveillance of RSV infection will provide information on the epidemiology in Aboriginal populations in the three Canadian territories. However, identifying the reasons why these communities are so affected will require additional research. Possible factors include exposure to environmental

tobacco smoke, sub-standard heating systems and maintenance, household crowding and lower rates of breastfeeding. This research will provide the basis for developing appropriate prevention and control measures.

While RSV vaccines are not yet available for use in public health programs, clinical trials are under way. Handwashing is a very effective way to prevent spread in families and institutions. Immunoglobulin preparations are available that can be given parenterally to prevent RSV infections. However, because of their high cost and impracticality (monthly intravenous or intramuscular injections during RSV season), they are recommended only for some high-risk infants and children during the RSV outbreak season to prevent severe RSV.

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Chapter 8 Cystic Fibrosis

Introduction

Cystic fibrosis, a chronic fatal respiratory disease, is the most common genetic disease among Caucasians in Canada.[1] Symptoms usually develop in the first few years of life. Individuals with cystic fibrosis produce abnormal mucous in the lungs that interferes with breathing and they are more prone to serious lung infections. They are unable to produce adequate pancreatic enzymes for the digestion of food, leading to malnutrition. While in the past, many children died before reaching the age of 20, the current average age of survival is the mid-30s.

Individuals with cystic fibrosis are more susceptible to serious lower tract respiratory infections. Usually preceded by viral illnesses, respiratory exacerbations are frequently associated with the common pathogen *Staphylococcus aureus* and the unusual pathogen *Pseudomonas aeruginosa*. This increases the rate of destruction of the lung.

Successful therapy includes nutritional and pancreatic enzyme supplements and regular physiotherapy. Prompt treatment with antibiotics for respiratory infections is also a critical element of a comprehensive program. More aggressive early treatment with antibiotics and aggressive nutritional programs has helped not only to prolong the lives of these individuals with cystic fibrosis, but also to improve the quality of their lives.[2]

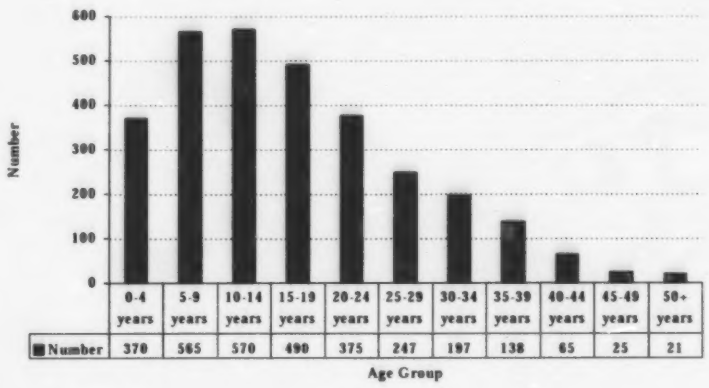
Cystic fibrosis exerts a tremendous impact on families. Physiotherapy that must be performed by a parent or other adult can take up to 2 hours per day, and giving inhaled medication can require up to an hour per day. The cost of medication incurs a significant expense. And the overall concern about the eventual death of the child, punctuated by serious bouts of illness requiring hospitalization, weighs heavily on the family's emotions.

Incidence/Prevalence

Cystic fibrosis is an autosomal recessive genetic condition with a carrier rate of one in 25.[3] Based on the probability that a man and woman who are carriers will meet is one in 625, and that one in four of their babies will develop the disease, the incidence of cystic fibrosis is estimated to be one in 2,500 births. According to the Canadian Cystic Fibrosis Foundation Registry, 3,142 people in Canada lived with cystic fibrosis in 1997: 54% were male and 46% were female.

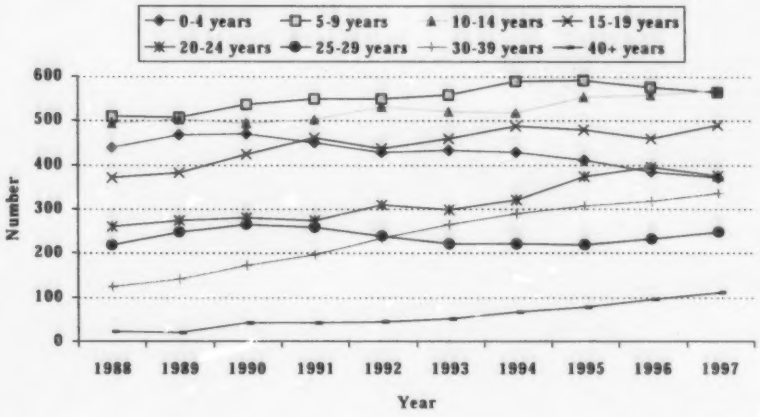
Most children are diagnosed with cystic fibrosis by the age of 5 years (Figure 8-1). While their numbers start to decrease after the age of 20, many individuals continue to live with the condition into their 30s or 40s.

Figure 8-1 Number of individuals with cystic fibrosis by age, Canada, 1997.



Source: Canadian Cystic Fibrosis Foundation's Canadian Patient Data Registry Report, 1997.

Figure 8-2 Number of individuals with cystic fibrosis by age, Canada, 1988-1997.



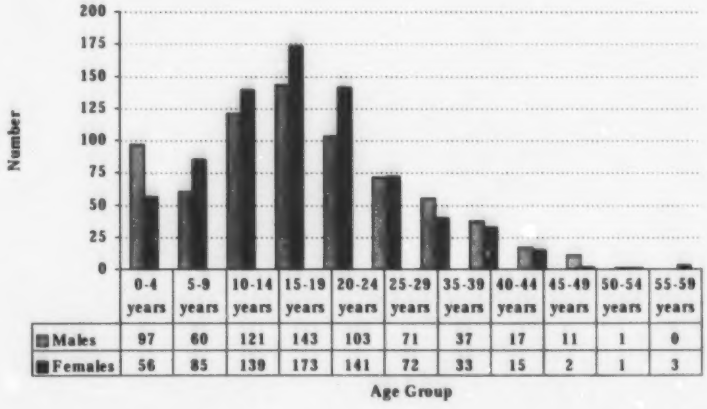
Source: Canadian Cystic Fibrosis Foundation's Canadian Patient Data Registry Report, 1997.

Between 1988 and 1997, the number of individuals with cystic fibrosis increased in all age groups except 0-4 years. The increase was greater among the older age groups (Figure 8-2). This reflects the increased survival rates.

Use of Health Services

Individuals with cystic fibrosis may require hospitalization during acute exacerbations of symptoms.

Figure 8-3 Number of hospitalizations for cystic fibrosis by age group and sex, Canada, 1998/99.



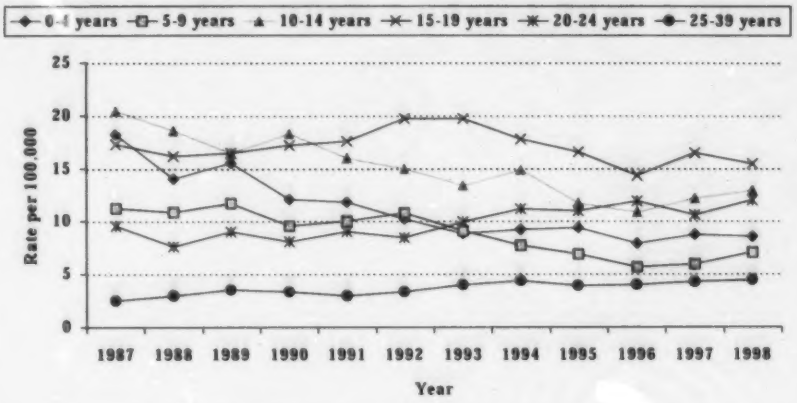
	0-4 years	5-9 years	10-14 years	15-19 years	20-24 years	25-29 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years
Males	97	60	121	143	103	71	37	17	11	1	0
Females	56	85	139	173	141	72	33	15	2	1	3

Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

In 1998, the number of hospitalizations for cystic fibrosis was greatest among individuals in their teen years. Between the ages of 5 and 24, girls were more likely than boys to be hospitalized. The lower number of hospitalizations in the 20+ age groups reflected the smaller number of individuals who survived into their 30s and 40s (Figure 8-3).

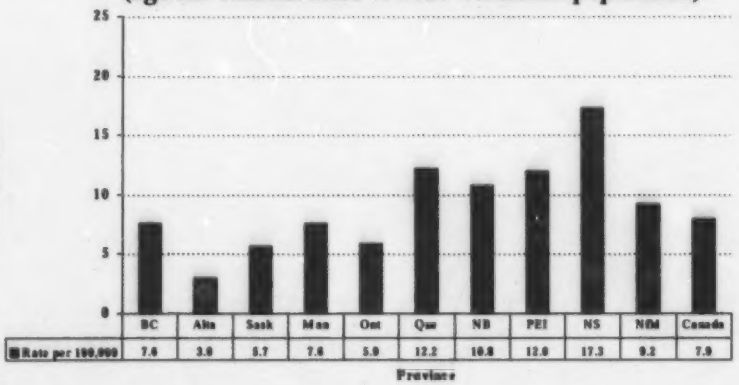
Between 1987 and 1998, hospitalizations due to cystic fibrosis decreased among all age groups under the age of 15 years, reflecting improved disease management. Hospitalizations among older age groups increased, and is likely attributable to the increase in the life expectancy (Figure 8-4).

Figure 8-4 Hospitalization rate per 100,000 for cystic fibrosis by age group, Canada excluding territories, 1987/88-1998/99.



Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

Figure 8-5 Hospitalization rate per 100,000 for cystic fibrosis among children and youth to age 39 years by province, Canada, 1996/97-1998/99 (three-year average) (age/sex-standardized to 1991 Canadian population).



Province	BC	Alta	Sask	Man	Ont	Que	NB	PEI	NS	NWT	Canada
Rate per 100,000	7.6	3.0	5.7	7.6	5.9	12.2	10.8	12.0	17.3	9.2	7.9

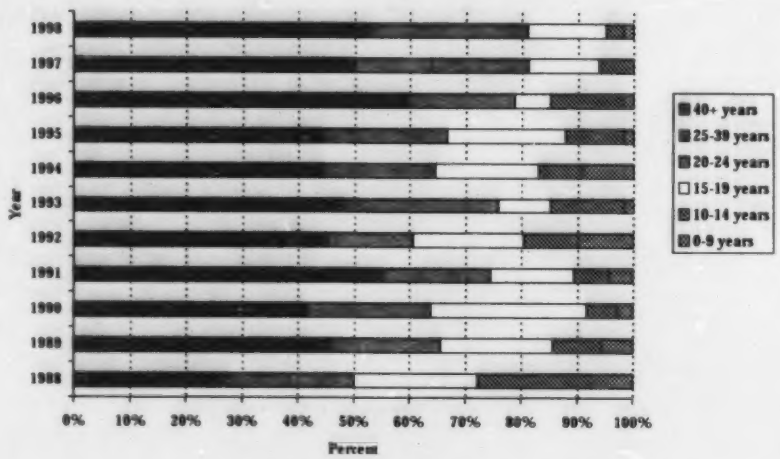
Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

In 1998, rates of hospitalization for cystic fibrosis appeared to be higher in the eastern provinces than in the western provinces (Figure 8-5).

Mortality

In 1998, there were 48 deaths due cystic fibrosis in Canada. Between 1987 and 1998, the distribution of the age of death due to cystic fibrosis showed a gradual shift to the 20+ age group. By 1998, 81% of all deaths due to cystic fibrosis were individuals in the older 20+ age groups, compared to only 46% 10 years earlier. In the last 3 years (1995 to 1998), only three children died who were under the age of 10 (Figure 8-6).

Figure 8-6 Proportion of deaths caused by cystic fibrosis in age group, Canada excluding territories, 1988-1998.



Source: Centre for Chronic Disease Prevention and Control, using Statistics Canada data.

Discussion and Implications

The face of cystic fibrosis has changed radically in the last 20 years. While it was once almost exclusively a child's disease, most individuals with cystic fibrosis are now living into their 20s and 30s. Unfortunately, these individuals also experience the impact of other health problems, such as male infertility, liver disease and diabetes.

This increase in survival has major implications for the health care system and the community at large. For example, while paediatric respirologists are very familiar with the disease, adult respirologists, who take over the management of cystic fibrosis of the children as they become adults, may not be as familiar with its treatment. This can result in frustration for both health care providers and the individuals. The health care system needs to become more responsive to the needs of adults with cystic fibrosis, particularly during the teen-to-adult transition period. It is in this age group that non-respiratory problems, such as diabetes and liver disease, become more troublesome.

Families of individuals with cystic fibrosis need significant support to cope with the many stresses imposed by the condition. Education and assistance can help them maintain a normal family life while coping with the huge physical demands associated with the disease, such as daily physiotherapy and medication.

Over the last 20 years, the Canadian Cystic Fibrosis Foundation has established cystic fibrosis centres across the country to provide a comprehensive range of services to families. The great gains that have been made in treatment and survival are due in a large degree to the work in these centres. One of their major benefits is the multi-disciplinary team of physicians, nurses, nutritionists and physiotherapists who work closely with the family to tailor the treatment to the individual's needs. The challenge now is to ensure that this high quality of service for children continues for adults. The other issue is access. Since the cystic fibrosis centres are in major cities, children and adults in outlying areas have difficulty in achieving full benefit from them. Many centres have outreach programs and smaller centres have linkages to teaching centres, but more funding is needed to expand the service.

Assistance with the expense of drugs is one very tangible way to provide support to families. Unfortunately, financial support for drugs varies considerably by province. Some provincial programs provide complete support, while others have various levels of subsidy. In addition, some provinces provide reimbursement for children's drugs, but not for those of adults. As more individuals live into adulthood, this becomes more of an influential factor in maintaining a reasonably active and varied life.

Lung transplants are an option during the end stage of cystic fibrosis disease. This option has limitations, however. Transplants are a very resource-intensive therapy. When successful, they do extend the individual's life and increase the quality of that life. Because of less-than-ideal methods of dealing with graft rejection, many individuals develop chronic graft failure a few years after transplant. This can lead to either the need for re-transplant or death.

Cystic fibrosis cannot be prevented. If there is a family history of cystic fibrosis, genetic testing can determine carrier status. Genetic counselling can then help a couple decide whether to have children or whether to use assisted reproductive technology to have a baby without the risk of cystic fibrosis. Screening of newborns can identify children who will develop cystic fibrosis. Debate exists about the usefulness of this procedure, however. While no treatment exists to prevent the disease, early aggressive treatment once symptoms develop can make a difference. Further analysis is needed to see whether screening has the potential to make a difference in the Canadian setting.

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Chapter 9
Respiratory Distress Syndrome (RDS)

Introduction

Respiratory Distress Syndrome (RDS) is also known as hyaline membrane disease. It is a condition predominately seen in premature infants, associated with severe breathing difficulty. RDS is caused by a primary deficiency of surfactant, which coats the alveoli (air sacs) in the lungs and prevents them from collapsing as the baby exhales.[1] As a result, the baby cannot take up enough oxygen.

The maturation of the baby's surfactant system occurs gradually in the third trimester of pregnancy. The point at which the system is sufficiently mature for RDS not to occur varies widely from one baby to another. In most infants the system is mature by about 36 weeks of gestation, but RDS can occur in full-term babies, particularly if the mother is diabetic. Conversely, a few infants of less than 30 weeks gestation may already have a mature surfactant system.

During its acute phase RDS commonly leads to significant complications. These include bronchopulmonary dysplasia, a chronic respiratory problem secondary to the effect of inflammation on the immature lung.[2] This may lead to prolonged hospitalization and significant post-discharge dependence on technology to assist with breathing. Babies with severe RDS may also develop other neurological complications that are commonly associated with prematurity, such as intraventricular bleeding and periventricular leukomalacia. These complications severely affect the child's development. Babies with RDS are also more likely to be diagnosed and hospitalized with asthma between the ages of 1 and 4 years.[3]

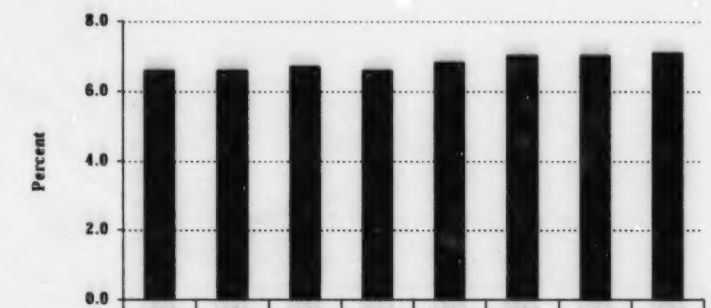
The prognosis for RDS has improved significantly over the last 30 years.[4] The widespread use of antenatal steroids that increases surfactant production in the fetus has contributed to this trend. In addition, the availability of a variety of surfactant treatments, which have been shown to be highly effective in decreasing morbidity and mortality, has improved the prognosis for those babies who develop RDS.[5]

Risk Factors and Prevention

Prevention of RDS could most effectively be accomplished by prevention of prematurity, but this remains an elusive goal.

Between 1990 and 1997 the rate of preterm birth in Canada increased (Figure 9-1). The exact cause for this increase is unknown, but a contributing factor is the increase in multiple births.[6] The increased use of assisted reproductive technology is part of this trend. In addition, a higher proportion of births is to older women who have a higher risk of multiple birth.

Figure 9-1 Rates of preterm birth (percent of livebirths), Canada excluding Ontario, 1990-97.



Source: National Perinatal Surveillance System, Reproductive Health Bureau, Health Canada.

Many hypotheses exist to explain the causes of preterm labour, but in many situations the underlying cause is unknown. Nonetheless, some risk factors have been identified, including cigarette smoking, stress, vaginal infection, multiple pregnancy, being under age 20 or over age 35, and inadequate nutrition and weight gain in pregnancy.[7]

Even if preterm birth cannot be prevented, the administration of a very short course of antenatal steroids (two doses 24 hours apart) to the mother has been shown to be highly effective in decreasing the severity and incidence of RDS.[8] Antenatal steroids also decrease the incidence of other important complications of prematurity, including intraventricular hemorrhage and bronchopulmonary dysplasia. According to the Canadian Neonatal Network database, in 1996/97, 29% of infants $\leq$34 weeks gestation received a complete course of antenatal steroids, 25% received a partial course, and 39% received no steroids. In 7% of cases, steroid use was unknown.

Incidence/Prevalence

In the pre-steroid era, RDS was seen in at least 50% of infants weighing between 1,000 and 1,500 g., decreasing to 5% of infants between 2,000 and 2,500 g.[9] These numbers have decreased due to the use of antenatal steroids.[10]

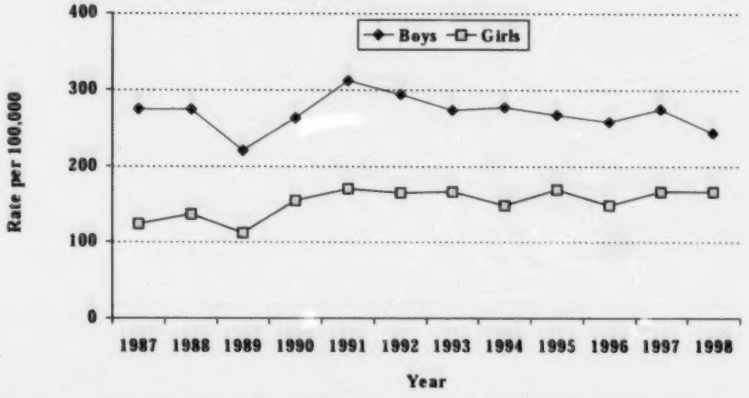
In spite of the advances gained by antenatal steroid use, the risk of RDS remains a reality. For example, in 1999 in one Canadian neonatal intensive care unit where greater than 80% of infants eligible for antenatal steroids received partial or complete treatment, 44% of infants less than 1,500 g. still required treatment with surfactant and two-thirds required a period of assisted ventilation.[11]

Hospitalization

Since most babies are born in hospital, hospitalization rates for RDS can serve as a proxy for the incidence of RDS.

While there were fluctuations in the hospitalization rate for RDS among children of both sexes between 1987 and 1998, the rates for both boys and girls remained relatively constant from 1993 forward (Figure 9-2). The ratio of boys to girls with RDS is 1.6:1.

Figure 9-2 Hospitalization rate (per 100,000) for respiratory distress syndrome (RDS) for infants to age 12 months by sex, Canada excluding territories, 1987/88-1998/99.



Source: Centre for Chronic Disease Prevention and Control, Health Canada using data from Hospital Morbidity File, Canadian Institute for Health Information.

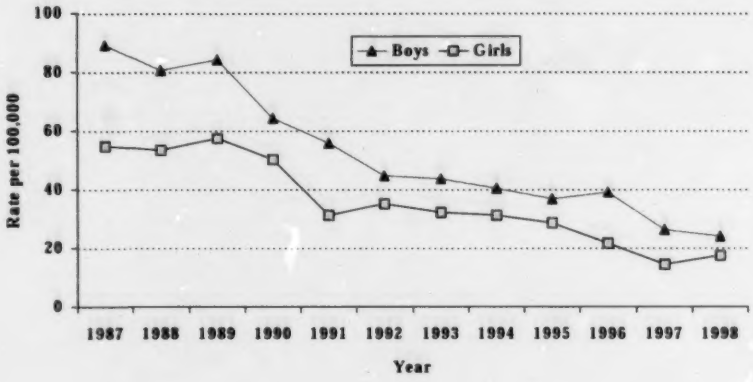
RDS requires the expenditure of major health financial resources. The need for assisted ventilation comprises one of the major costs of the care of premature infants. For example, in a typical Canadian neonatal intensive care unit in 1998, direct in-hospital costs for a baby under 25 weeks gestation exceeded $100,000, with indirect costs adding an additional 30%.[12] Data from the Canadian Neonatal Network reveal that in 1996-1997[13] infants of less than 750 g. spent an average of 40 days on assisted ventilation decreasing to about 5 days for babies 1,500 to 2,500 g.[14]

Mortality

Although the last two decades have seen significant advances in prevention and treatment of RDS, this condition remains the major cause of death in babies born prematurely.[15]

Mortality rates from RDS for infants under 1 year old declined steadily between 1987 and 1998. Rates for boys continued to be higher than for girls (Figure 9-3).

Figure 9-3 Mortality rates (per 100,000) for respiratory distress syndrome (RDS) for infants to age 12 months, Canada, 1987-1998.



Source: Centre for Chronic Disease Prevention and Control - Using Statistics Canada Data.

Antenatal steroid use and surfactant treatments have contributed to increased survival rates among preterm babies. While the mortality rate for 1,000 to 1,500 g. infants in 1961 was reported as 66%, this has now decreased to less than 20%.[16] Even for babies of less than 750 g. who rarely survived in 1961, survival is now greater than 75%.

Discussion and Implications

RDS is a serious condition that primarily affects infants that are born prematurely. It has a major impact on the health of the child, induces great stress on the family and requires a considerable expenditure of health care resources.

Hospitalization data suggest that the rate of RDS has not changed. While the decrease in mortality rates does attest to the success of treatment in the modern neonatal intensive care unit, further improvements in neonatal health will require the prevention of preterm birth, the underlying cause of RDS.

Unfortunately, the incidence of preterm births is increasing rather than decreasing. Primary prevention of preterm birth includes the enforcement of guidelines regarding the use of assisted reproductive technologies to decrease multiple births. It also requires education and supportive public policies to promote healthy lifestyles among all pregnant women. Continued research into the causes of preterm birth will hopefully provide the basis for effective prevention programs in the future.

Population-based approaches to ensure early intervention and effective management are urgently required to reduce the risk of RDS when preterm birth occurs. Widespread adoption of antenatal steroids for threatened preterm delivery has significantly improved the prognosis for RDS. Despite the known benefits of these steroids, however, many preterm babies still do not receive them. Since the steroids must be started 48 hours prior to the birth to be of optimal benefit, it is essential that women come to the hospital as soon as preterm labour starts. Drugs to stop preterm labour can delay birth for up to 7 days and provide time for the administration of antenatal steroids.[17] Therefore, all women must know the signs and symptoms of preterm labour and health care providers must be ready to respond appropriately.

Adequate surveillance data would improve our understanding of RDS at the population level. Most current information on RDS comes from single or multiple centre databases and clinical trials. No systematic approach to the collection of data in a timely and comprehensive manner currently exists. Comprehensive population-based data on the incidence and outcome of preterm birth and RDS would greatly facilitate the development of research and preventive strategies.

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Glossary

Age-standardized - A technique used to remove as far as possible the effects of differences in age when comparing two or more populations. In this report, the population 5-year age-specific rates for each year were applied to the 1991 Canadian population (the standard population) in 5-year age groups to obtain the overall yearly rate.

Asthma (ICD code 493) - A chronic disorder characterized by symptoms of cough, shortness of breath, chest tightness and wheeze.

Bronchiolitis (ICD code 466.1) - Inflammation of the smaller airways in the lung usually caused by bacterial or viral infection.

Chronic Obstructive Pulmonary Disease (COPD) (ICD code 490-492, 496) - A chronic disease with shortness of breath, cough and sputum production most commonly caused by chronic bronchitis and emphysema.

Current smoker - Individual was smoking at the time of the interview. A current smoker is either a daily smoker or an occasional smoker.

Cystic fibrosis (ICD code 277.0) - A chronic genetic disease that causes individuals to produce abnormal mucous in the lungs that interferes with breathing and affects the ability of the pancreas to produce sufficient enzymes needed for the digestion of food.

Daily smoker – Individual was smoking cigarettes daily at the time of the interview.

Environmental tobacco smoke (ETS) – ETS, also known as passive smoking, refers to exposure from smoke produced from cigarettes.

Former smoker - Individual was not smoking at the time of the interview. However, the individual had smoked at least 100 cigarettes during his/her lifetime.

High sampling variability (NPHS) – The National Population Health Survey samples a segment of the population to obtain an estimate of the prevalence of specific variables. Because only a sample is surveyed rather than the whole population, a coefficient of variation is calculated for each variable estimate. This coefficient is dependent in part on the sample size. When it exceeds a certain level, interpretation requires caution because the actual value could vary considerably from the estimate obtained in the survey. In this report the following values were used to define high sampling variability

0 – 16.5 % = reliable estimate
16.5 – 25.0 = high sampling variability of estimate
$\geq$ 25.1 = estimate not used for this report

Hospital and mortality projections for COPD - Trends in age- and sex- specific mortality and hospitalization rates from 1971 to 1996 were extrapolated to estimate rates in the future. These rates were then applied to population projections from Statistics Canada to estimate the number of hospitalizations and deaths from COPD in the future.

Hospitalization Diagnosis – Each time an individual leaves hospital (discharge, transfer or death) a record is completed listing one or more diagnoses that contributed to the hospital stay. The Main Diagnosis is the most significant condition responsible for the longest stay in hospital. Up to 15 other conditions that were also present may also be listed. This report uses the Main Diagnosis for all analyses except Figures 1-3, 1-4 and 1-5 where the presence of the specific condition in any one of the first five diagnostic fields was included in the analysis.

Incidence (or incidence rate) - The number of new cases that occur in the population at risk during a specific time period (Incidence rate is the number of new cases divided by number of susceptible individuals in the population commonly during a one-year period).

Income adequacy - This variable is derived for four categories based on household income and the size of the household for 1998 (Statistics Canada).

Description	Income	Household Size
Lowest income	Less than $15,000	1 or 2 persons
	Less than $20,000	3 or 4 persons
	Less than $30,000	5 or more persons
Lower middle income	$15,000 to $29,999	1 or 2 persons
	$20,000 to $39,999	3 or 4 persons
	$30,000 to $59,999	5 or more persons
Upper middle income	$30,000 to $59,999	1 or 2 persons
	$40,000 to $79,999	3 or 4 persons
	$60,000 to $79,999	5 or more persons
Highest Income	$60,000 or more	1 or 2 persons
	$80,000 or more	3 or more persons

Influenza (ICD code 487) – Infection by the influenza virus that causes mild to severe respiratory symptoms.

Lung cancer (ICD code 162) – Abnormal growth of lung tissue (neoplasia)

Occasional smoker – Individual was smoking cigarettes occasionally (not on a daily basis) at the time of the interview.

Pneumonia (ICD code 480-486) - Inflammation of lung usually caused by bacterial or viral infection.

Preterm birth rate - The proportion of live births with a gestational age at birth of less than 37 completed weeks (259 days or less) in a specific place and time.

Prevalence (point prevalence)- The proportion of the population who report a behaviour or have a health problem at a certain point in time.

Respiratory Distress Syndrome (RDS) (ICD code 769) – A condition of newborns that results in breathing difficulties due to a deficiency of lung surfactant, which coats the alveoli (airs sacs) to prevent them for collapsing as the baby exhales.

Respiratory Syncytial Virus (RSV) – A virus that causes both upper and lower respiratory symptoms. It is the underlying cause of most cases of bronchiolitis and pneumonia in children under 2 years of age.

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	Yes	No
1. Do you cough, wheeze, or have a tight chest because of your asthma? (4 or more days a week)	☐	☐
2. Do coughing, wheezing, or chest tightness wake you at night? (1 or more times a week)	☐	☐
3. Do you stop exercising because of your asthma? (In the past 3 months)	☐	☐
4. Do you ever miss work or school because of your asthma? (In the past 3 months)	☐	☐
5. Do you use your blue inhaler 4 or more times a week? (Except one dose/day for exercise)	☐	☐

If your patients answered "yes" to one or more questions, their asthma may be uncontrolled.

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